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Montessori Teacher Training Program
1966 ~ 1967

Teacher's Manual

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PRACTICAL LIFE EXERCISES

APPLIED EXERCISES OF PRACTICAL LIFE

I CARE OF THE INDOOR ENVIRONMENT

- A. Chairs in order after use.
- B. Tables in order after use.
- C. Carrying object back to its place after it is used.
- D. Sweeping mats.
- E. Sweeping floors.
- F. Dusting all furniture.
- G. Laying and clearing the table.
- H. Washing and polishing furniture.
- I. Sweeping the floor.
- J. Washing dirty dustcloths, etc.
- K. Checking apparatus for neatness, completeness and order.
- L. Arranging flowers.

II CARE OF THE OUTDOOR ENVIRONMENT

- A. Weeding.
- B. Taking dead leaves from plants.
- C. Raking leaves.
- D. Watering plants.
- E. Gathering wood into bundles.
- F. Gathering fruit.
- G. Planting flowers
- H. Sweeping walks around the school.

III CARE OF THE PERSON

- A. Washing hands and face.
- B. Cleaning teeth.
- C. Combing hair.
- D. Fastening coat, pants.
- E. Tying shoes.
- F. Bathing and showering.
- G. Cleaning nails.
- H. Cutting nails.
- I. Folding clothes.
- J. Dressing and undressing.
- K. Folding clothes.

IV SOCIAL RELATIONS

- A. Bowing, shaking hands and other greetings.
- B. Offering something to someone.
- C. Inviting someone to something.
- D. Making way for someone to pass.
- E. Begging someone's pardon.
- F. Blowing nose.
- G. Helping someone to help himself.

V CONTROL OF MOVEMENT

- A. Walking on the Line.
- B. The Silence Game.

PRELIMINARY EXERCISES IN PRACTICAL LIFE

I PRE-TABLE WASHING EXERCISES

- A. Turning a faucet on and off.
- B. Squeezing a sponge.
- C. Using a mop.
- D. Folding cloths.
- E. Using a brush.
- F. Rolling a mat.
- G. Putting on and taking off an apron.
- H. Pouring exercises.

II EXERCISES WITH WATER

- A. Pouring rice from one vessel to another.
- B. Pouring water from one vessel to another.
- C. Filling a jug.
- D. Pouring water into a cup.
- E. Washing hands.
- F. Washing the top of a table.
- G. Washing and drying glasses.
- H. Pouring liquids ie. juice, milk.
- I. Washing dishcloths, dusters.
- J. Washing dishes.
- K. Washing mirrors, window panes.

III EXERCISES IN CARRYING

- A. Chairs, tables.
- B. Flowerpots.
- C. Crockery.
- D. Pails, basins.
- E. Jugs.
- F. Objects back to their places.
- G. Glasses.
- H. Silverware.
- I. Scissors or any other pointed object.
- J. Laying and clearing away of a table.

IV EXERCISES IN POLISHING

- A. Tables.
- B. Chairs.
- C. Brass.
- D. Silverware.
- E. Shoes.
- F. Floor.

V EXERCISES OF OPENING AND SHUTTING

- A. Room doors and cupboards.
- B. Windows.

PRELIMINARY EXERCISES - CONTINUED

- C. Boxes of different shapes and sizes.
- D. Trunks.
- E. Window shutters.
- F. Drawers of different width and sizes.
- G. Bottle tops.

VI EXERCISES IN FOLDING AND PACKING

- A. Tablecloths and napkins.
- B. Dusters, washcloths, hand towels.
- C. Mats.
- D. Paper.
- E. Lunchbox.
- F. Basket for a picnic.
- G. Apparatus used.

VII EXERCISES IN CUTTING

- A. Scissors with rounded edges.
- B. Flower stalks.
- C. String on parcels.
- D. Mats for trays.
- E. Dry twigs from faded plants.
- F. Peeling potatoes, fruit.
- G. Bread.
- H. Paper.
- I. Cloth.

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- A. Can opener/bottle opener.
- B. Vacuum cleaner.
- C. Loading dishwasher.
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- E. Using sewing machine.
- F. Using an iron.
- G. Operating a tape recorder
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- I. Using various locks and keys.

IX EXERCISES IN CARPENTRY

- A. Hammering.
- B. Sanding wood.
- C. Sawing wood.
- D. Measuring with a straight edge.
- E. Sorting nails.
- F. Using screwdriver.

POURING RICE

I MATERIAL

1. Two receptacles with lips.
 - a. straight sided.
 - b. breakable.
 - c. same size.
2. Small tray
Colored so that the fallen rice may be seen.
3. Rice - $\frac{3}{4}$ of a jug.

II DIRECT AIM

1. Preparation for pouring water.
2. Control of an action.
3. Indirect preparation for writing.
4. Order of action.

III PRESENTATION

1. Get the tray from the shelf and place it on the table.
2. Lift the pitcher that is full of rice with the right hand if the child is righthanded, and with the left if he is lefthanded.
3. Place the lip of the rice pitcher over the center of the circumference of the empty pitcher.
4. POUR - at first slowly, then more quickly.
5. Be sure that all the rice comes out of the pitcher.
6. Place the now filled rice pitcher on the right hand side and the empty one on the left side.
7. Turn the handles of the pitcher toward the outside.
8. If any grains should fall pick them up one at a time using the thumb and forefinger.
9. Be sure to always pour from left to right.

IV POINT OF INTEREST

Notice that you have spilled no rice.

V AGE

2-3 yrs.

VI CONTROL OF ERROR

Rice seen on the tray.

POURING WATER

I MATERIAL

1. Plastic mat.
2. Tray.
3. Jug - $\frac{3}{4}$ full.
4. Receptacle into which water is poured.
5. Cloth which is $\frac{1}{4}$ of a washcloth.

II DIRECT AIM

1. To teach the child to pour water from one vessel to another.
2. Exact muscle control, and exactness of an action.

III PRESENTATION

1. Place the plastic mat on the table, and place the tray with all the items on it on the mat.
2. Place the cloth on the right side of the mat.
3. Follow the same steps as in rice pouring (A-F).
4. Wait for the last drops to fall; if they do not use the cloth to wipe them off the lip of the jug.
5. Pour the water from one jug to the other two or three times.
6. Place all the items back on the tray, and return the tray to the shelf.
7. Fold the mat. Put it beside the tray or on top of it.

IV EXERCISE

1. As presentation.
2. Instead of using two jugs, one jug is used with three smaller receptacles of the same size.
 - a. Proceed as above.
 - b. After the water has been poured into the three receptacles the water from each of them is poured into the sink, and each one is dried and placed back on the tray. The jug is refilled with water and placed on the tray; then the tray is returned to the shelf.
3. A jug and two different size receptacles.
Do the same as in 2..
4. Pour water from the jug into a container which is standing on the tray. There should be no hands on the container being filled.
5. Water plants.
6. Pour water from one jug to another by holding jug with the water at different heights.

V AGE $2\frac{1}{2}$ - $3\frac{1}{2}$.

VI CONTROL OF ERROR Spilled water.

WASHING A TABLE

I MATERIALS

1. Cloth or oil cloth for the floor.
2. Jug which has a belly. This should have water in it.
3. Basin.
4. Pail.
5. Dish for the sponge.
6. Dish for soap and scrubbing brush.
7. Drying cloth.
8. Apron.

II DIRECT AIM

1. Care of the environment.
2. Control of action.
3. Order and sequence of each action.

III PRESENTATION

1. Take the floor cloth and place it on the floor next to the table.
2. Carry over the basin with two hands under the rim. It should also be held away from the body.
3. Carry over the two dishes, one in each hand. Place them on in front of the basin. The basin and the dishes ought to be closer to the table.
4. Carry over the pail, and place it next to the basin.
5. Carry over the jug which has $\frac{1}{3}$ water in it.
6. Pour the water from the jug to the basin by holding the handle and belly of the jug.
7. Wet the sponge, and squeeze it with both hands; squeeze the sponge until no drops fall.
8. Starting with the far half of the table, wet table. Motion is from left to right, away from self.
9. Eye the table to see if it is wet.
10. Dip the bristles of the brush into the water in the basin, then give the brush one hard downwards shake so that the excess water will fall from the brush.
11. Apply the soap to the brush by holding it underneath the bristles and sliding it across it.
12. Scrub the table using a circular motion.
13. Rinse the table with a sponge. See step 7.
14. Dry the table with the drying cloth.
15. If only half of the table has been washed continue washing the other half. See steps 8-14.
16. Dry the soapdishes, brush and jug.
17. With the hand clean the scum from around the sides of the basin.
18. Pour the water from the basin to the pail. Watch for the last drop to fall.
19. Dry the inside and bottom of the basin.

WASHING A TABLE - CONTINUED

20. Carry the pail to the sink and empty it. Then dry it.
21. Take one item at a time back to its place, except for the soapdishes which may be carried back together.

IV EXERCISE

Repeat as much as he can until the child is able to do the whole process well.

V POINT OF INTEREST

1. The soap on the surface of the table.
2. Seeing the difference between the clean and uncleaned part of the table.

VI AGE

2½-4 yrs.

VII CONTROL OF ERROR

1. No dirt.
2. No spilled water.

Note: Dusting, washing and polishing may follow one after the other.

CONTROL OF MOVEMENT

WALKING ON THE LINE

I MATERIAL

Line which is shaped like an ellipse. It should be painted or taped on the floor. The best way to make the ellipse is to make two long parallel lines, and join them with arcs.

II DIRECT AIMS

1. To achieve perfection of balance and coordination of movement.
2. Combining movement and music.
3. Understanding music through movement.

III PRESENTATION

This should be done as a group exercise. Start with a small group and then gradually add the whole class. Play slow music and have the children walk on the line. Children should maintain an equal distance between one another.

The two feet should be on the line in a heel toe movement.

Head must not be looking at the feet.

Add more children as the walking group perfects what you have presented.

There is no leader in this activity. Each child is one in the group activity.

IV AGE

3 yrs. onwards.

V CONTROL OF ERROR

Stepping off the line, loss of balance, dropping and spilling objects.

VI VARIATIONS

1. Have the child hold something on one hand ie. of a country.
2. Walk on the line holding two flags.
3. Walk holding a glass full of water.
4. Walk holding part of the pink tower.
5. Walk holding a bell.
6. Hold a ball on a string and try not to make the ball swing.
7. Walk with something on the head.
8. Walk with something on the head and in each hand.
9. Walk holding a lit candle.

ARRANGING FLOWERS

I MATERIALS

1. Oil cloth.
2. Tray of flowers.
3. Vases of various shapes and heights.
4. Pitcher of water.
5. Basin of water in which the flowers are placed after they are cut and before they are arranged.
6. Scissors.
7. Pail, not the same one as the one used for washing the table.
8. Drying cloth.

II DIRECT AIM

To teach sense of discrimination of sizes of vases and flowers.

INDIRECT AIM

To aid in developing an aesthetic sense.

III AGE

3 yrs. onwards.

IV PRESENTATION

1. Spread the oil cloth on the table.
2. Place the tray on the oil cloth; take everything off the tray except the flowers.
3. With the scissors snip off the end of the stem, and take off the dead leaves and the leaves at the bottom of the stem.
4. Put the snipped flowers in the basin.
5. Do as many flowers as you will need to fill the vases, leave the rest for other children to arrange.
6. With the pitcher of water fill the vases you are going to use.
7. Arrange the flowers into the vases according to the size of the flowers and the vase.
 - a. Do not put all the same size and shape flowers in one vase.
 - b. Do not squash the flowers together.
 - c. Vary the colors of the flowers.
8. Clean up.
 - a. Put the cut leaves and stalks into the pail.
 - b. Dry the tray with the cloth.
 - c. Dry the scissors.
 - d. Put the vases of flowers around the room.
 - e. Pour the water from the pitcher and basin into the pail, and dry them with the cloth.
 - f. Replace everything on the tray and put it on the shelf.
 - g. If there are some flowers left, leave them on the tray for another child to arrange.

ARRANGING FLOWERS - CONTINUED

V POINT OF INTEREST

1. Cutting the stalk.
2. Removing the leaves.
3. Choosing the appropriate vase for the different size flowers.
4. Deciding where to place the vases after they are arranged.

BUTTONING FRAME

I MATERIAL

A wooden frame with 2 rectangular pieces of sturdy fabric attached to two parallel sides of the frame. The two loose sides of the pieces of fabric over-lap when extended toward the middle of the frame. One flap has 4 or 5 large buttons sewn at intervals along the free edge, the other flap has corresponding button-holes. (Other frames have varying sizes of buttons decreasing in size inducing more exercise, practice, dexterity, manipulation and control of hand.)

II AIMS

DIRECT AIM

1. Motive of activity.
2. Acquisition of control and coordination.
3. Gaining of independence.
4. Care of person.

III INDIRECT AIM

1. Learning to dress and undress by practicing mechanism of buttoning and unbuttoning.
2. Practicing manipulative exercise.
3. Development of concentration, discipline, self-reliance and other qualities of character.

IV PRESENTATION

Invite the child to do the exercise. Get the apparatus from its place, carrying it in both hands and bring it to a small table and quietly place it there in front of the child. Comment on the buttons, pointing them out and proceed to show the exercise.

V EXERCISE

1. Unbuttoning -- have the top flap on your left. Begin at the top of the frame. Take button-hole flap in right hand with thumb on top of button. Tilt button with left hand and push side of button into button-hole halfway. Release flap with right hand and grasp button from underneath. Grasp flap with left hand and continue drawing out button with right hand. Proceed down the flap continuing to unbutton each of the buttons similarly. Open out flaps wide.
2. Buttoning -- first bring flap with buttons to the center and lay smoothly. Next bring flap with buttonholes to center and lay directly on top of first flap so buttons are aligned directly under button-holes. Starting at the top, left button-hole flap with left hand to expose underside of button-hole. Pick up button with right hand placing thumb on top of button. Tilt button and slide its side into the button-hole halfway. Release the flap with the left hand and grasp

BUTTONING FRAME - CONTINUED

button. Release button with right hand and grasp edge of flap. Draw button through the hole with the left hand. Give it a slight turn and release it. Continue down the frame until all buttons are secured in their corresponding button-holes.

The child will carry out the exercise as often as he desires. See that the material is returned to proper place when finished.

VI AGE 2 to 4 years.

VII VARIATIONS

1. More frames with varying sized buttons and corresponding holes.
2. Dressing and undressing of dolls.
3. Practicing buttoning and unbuttoning of our coats, etc.
4. Buttoning and unbuttoning a dress or blouse that buttons in the back.

NOTE

If child succeeds in doing buttoning frame, but does it incorrectly second time, then teacher should present it again to bring order to the child's mind.

THE SNAPPING FRAME

I MATERIALS

A wooden frame with two rectangular pieces of material attached to two parallel sides of the frame. The two loose sides of material overlap when extended to the middle of the frame. One flap has seven or eight sockets, the other flap has seven or eight corresponding studs.

II DIRECT AIM

1. Care of person.
2. Motive of activity.
3. Gaining of independence.
4. Acquisition of control and coordination.

III INDIRECT AIM

1. Learning to dress and undress by practicing snapping and unsnapping.
2. Practicing manipulative exercises.
3. Development of self reliance, concentration, discipline and other qualities of character.

IV PRESENTATION

1. Unsnapping:
See that the top flap is on the right. Begin at the top of the frame. With the right forefinger on the top part of the top flap, and the right thumb on the inside of the top flap, and the left hand holding the left flap, pull the top part of the top flap back and look at the first snap (that is, the socket and stud attached). With the left hand firmly holding the top part of the left flap, and the right thumb and forefinger holding the top part of the right flap, pull the top flap back to the right, freeing the stud from the socket. Fold the right side of the material back to the right, and release the left hand from the socket fabric. Bring the fingers of the left hand down under the socket fabric. With the right thumb and forefinger close to the socket, pull the stud back to the right, freeing it from the socket. Fold the material back and continue to proceed down the flap, unsnapping each of the snaps similarly. Open out the flaps wide.
2. Snapping:
First bring the flap with the sockets to the center and lay smoothly. Next bring the flap with the studs to the center and lay directly on top of the first flap so that the sockets are aligned directly under the studs. Starting at the top, lift the stud fabric with the right hand to expose the stud and the socket. Slipping the left hand

THE SNAPPING FRAME - CONTINUED

palm upwards from below underneath the left flap, hold the socket flap in the left hand, with the left thumb and forefingers close to the socket. Hold the stud flap with the right hand, with the right thumb and forefingers close to the stud. Place the stud into the center hole of the socket and push the stud and socket toward each other until they are fastened into place. Place the fingers of the left hand under the socket flap and left thumb next to the socket. Pull the next stud towards the socket and push the center of the stud into the center of the hole of the socket, snapping into position. Continue down the frame in a similar manner until all the studs and sockets are in place. Continue to do the exercise as often as is desired. Return the material to its proper place.

V AGE Two to four years.

VI VARIATION

Unsnapping and snapping all types of clothes.

BOW FRAME

I MATERIAL

A wooden frame with flaps of cotton fabric attached, one on each side of frame. Flaps are fastened in the middle, from top to bottom, by five pairs of ribbons tied into bows. There are five red ribbons on the right side and five white ribbons on the left.

II DIRECT AIM

1. Motive for activity.
2. Development of concentration.
3. Control and coordination of movement.
4. Gaining of independence.
5. Tying shoes and other articles of clothing.

III PRESENTATION

1. Unfastening: Red top. Red point to right. Red over white. White loop left. Red over loop from bottom. Pull unlooped ends of the ribbons using the thumb, first and second fingers of each hand. Unloop ribbons and extend each back over its own flap, one at a time. While doing so, steady flap with free hand so that it does not turn back. Repeat the exercise with additional bows.
2. Fastening: Cross first pair of ribbons at the top so that white ribbon extends across right flap and red ribbon is extended across left flap, seeing that they are crossed and extended smoothly. Cross remaining pairs of ribbons in the same manner. Hold ribbons, one in each hand, in the middle where they are crossed. Place red ribbon over white and while holding white ribbon, push red ribbon under it. Pull ends of ribbons and extend them smoothly, back over the flaps. Repeat process with remaining pairs of ribbons, working from top to bottom. Grasp white ribbon with one hand and loop it smoothly over thumb of other hand. Pull the loop so that when expanded, it consists of about $\frac{1}{2}$ of ribbon. Continue holding white loop with one hand, grasp red ribbon with other hand and bring it over white loop and then pass it underneath it. This makes an underloop through which the red ribbon is pulled. The red ribbon is pulled so that a loop is made equal to the white loop. Gently pull both loops. There is now a loop which extends over each flap. The end of the white ribbon on the right side smoothly over the red loop. The white loop lies smoothly over the end of the red ribbon on the left side. Repeat the process with the four remaining pairs of ribbons. Lift frame with both hands and return it to its place on the shelf.

BOW FRAME - CONTINUED

IV - AGE Three to five years.

V VARIATIONS

1. Inverting frame so that red and white ribbons are switched.
2. Eventually carrying out the whole exercise with ribbons of the same color.

THE HOOKS AND EYES FRAME

I MATERIAL

A wooden frame with two rectangular pieces of fabric attached to two parallel frames. The two loose sides of the pieces of fabric overlap when extended toward the middle of the frame. One flap has six or seven hooks and the other flap has six or seven corresponding eyes.

II DIRECT AIM

1. Motive of activity.
2. Acquisition of control and coordination.
3. Gaining of independence.
4. Care of person.

III INDIRECT AIM

1. Learning to open and close certain things or articles by practicing certain mechanisms of hooking and unhooking.
2. Practicing manipulative exercise.
3. Development of discipline, concentration and self-reliance.

IV PRESENTATION

1. Unhooking -- Have the top flap on your right. Begin at the top of the frame. With the right thumb on the inside of the top flap and the right forefinger on the top side of the same piece, pull it back towards the right and look at the first hook and eye, which are attached. Place the left forefinger under the bottom flap, from the top end, and the left thumb on the sewn part of the eye. With the right hand, tug the hook from the eye. Fold the right side of the material back to the right and release the left hand from the eye fabric. See that the right thumb and forefinger are as close as possible to the eye, when releasing the hook from the eye. Continue to unfasten each of the hooks and eyes similarly. Open out flaps wide.
2. Hooking -- First bring the flap with the eyes to the center and lay smoothly. Next bring the flap with the hooks to the center and lay directly on top of the first flap, so that the eyes are aligned directly under the hooks. Starting at the top, lift the hook flap with the right hand to expose the hook. Slipping the left hand palm upwards from underneath, hold the eye flap with the left thumb on the sewn end of the eye and the left forefinger under the fabric of the eye. With the right hand as close to the eye as possible, pull the hook towards the eye so that the end of the hook is slipped into the eye. Pull the hook through the eye and release the left and

THE HOOKS AND EYES FRAME - CONTINUED

right hands. Continue hooking down the frame until all loose hooks are secured in their corresponding eyes. See that all the fingers of the left hand are underneath the eye flap. The child will carry out the exercise as often as he wishes. See that the material is returned to the proper place when finished.

V AGE Two to four years.

TEACHER'S ART MANUAL

Pre-school program

by Lucia Pearce

Copyright, 1966

TEACHER'S ART MANUAL

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CHILDREN'S ART: A MONTESSORI APPROACH

By Lucia Pearce

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Director of Art Education, Montessori Teacher Training Program (Los Angeles)

In lecturing to teachers and parents on art and visual education, I often hear criticisms of Montessori's so-called by-passing of "creative expression", "fantasy", or "free, imaginative play". It is felt that the Montessori Method frustrates the child's natural capacity and need for original invention and expression in music, poetry, dramatic and plastic arts. Although I do not agree that this is true theoretically, there is a kernel of truth in these criticisms regarding Montessori in practice. Dr. Montessori herself had little to say about "art", and what she did say seems very inadequate. The fact is that the Montessori Method has not distinguished itself in the area of expressive art (for communication) or in "scientific design" (original invention by the child himself). But I see no reason why a Montessori approach to art (making) cannot be developed. Indeed, it seems to me that it must be developed.

A major obstacle to such a development is the common view of "art" held by many teachers and parents—a view which they were taught as school children. This view has caused adult blindness to the great vitality and significance of the spontaneous art work of young children. For instance, adults have a preconceived (and dated) notion of what "correct" drawing is: a kind of pseudo-photographic realism. The child and his worth as an artist are measured against this adult ideal and, consequently, the child's spontaneous drawings are interpreted as "awkward", "unrealistic", lacking in perspective, out of proportion, and so on. His drawings are seen as being "incorrect". So in order to "correct" him, the adult gives the child a nice, neat formula: tracing or copying exercises, and so-called self-correcting coloring books.

Because these are generally accepted practices in many schools and especially in homes, Montessorians (professionals and laymen) would do well to examine them critically as to their compatibility with Montessori's philosophy. Montessorians must also beware of falling into the easy error of trying to apply Montessori's concept of self-correcting instructional materials in an area where it simply is not applicable.

And what is wrong with the coloring book and copy exercises? First of all, they place all the emphasis on the finished product with complete disregard for the processes of seeing, discovering, and making (creating new relationships). The prime importance of these processes to the child is ignored. The ready-made image in the coloring book actually frustrates the child's natural urge and need to see the world around him and to translate and organize his own unique observations and insights into new symbol patterns. Whereas a Montessori approach is based on the child's ability and need to discover and do for himself, the coloring book, paint-by-number kits, and other such devices render the child utterly dependent on the adult. The coloring book is the adult's way of saying: "Don't think, dear, don't create your own images from your own experiences. Just color inside the lines and use the colors I tell you to use, the 'correct' colors. Don't try to re-create your own experience of a man or a tree. Use my man and my tree and just fill them in." This, of course, confuses genuine, original making (art) with manual dexterity. It also leaves the child with a lack of self-confidence in his own first-hand experiences. It produces unoriginality, conformism. This is an authoritarian approach to something

mistakenly called "Art", and as such, it has no place as part of or supplementary to a Montessori program. In fact, it defeats the fundamental purpose of Montessori education.

Also, these devices violate the Montessori principle that the hand and mind must work together. Coloring books, copying, tracing all lead to the separation of the child's emotional response to reality from the work of his hands. This is a fatal split which leads to sterility and a preoccupation with facile techniques and easy, thought-free formulas. To those who protest, "But my child LOVES coloring books", I would say that you and your child are being deluded into thinking that he has made something, when in fact he has made nothing at all. He has simply gone through the motions.

Concerning fool-proof formulas, it is important to point out a major tendency in art education in this country, especially common among professional educationists in the public schools. This is the "artsy-craftsy" approach and is typified by the numerous do-it-yourself books featuring "holiday arts"; clever ways to make "cute" little bunnies, Christmas trees and ornaments and other such items. Glitter and macaroni mosaics are the rage, as are jewelry boxes made of egg cartons. All this can be described in one word—"corny". Under the guise of "festive fun", this approach offers an easy, thought-free (for teacher and student) time-filler. This is not to say that worthwhile art activities have no place as part of celebrations. They do, if the holiday celebration is genuine and meaningful. But to allow "holiday arts" to assume a role of major importance in an art education program, as it has in many schools, is pathetic.

Surely children are capable of far more than this. Surely they are able to create their own symbols rooted in their own unique observations and insights. The "artsy-craftsy" approach is simply an inane, hand-me-down symbol system without roots in real experience, dreamed up by adults who think they know what children like. (Note the "cute" pink and blue animal decals which grace most items of baby furniture on the commercial market.) And if children grow to "like" it, this is because they have been introduced to nothing better, i.e. more meaningful.

Again, the major problem is adult blindness and misunderstanding of the symbols which young children form spontaneously, and of the relation of these symbols to "reality" as the child perceives it. With regard to the very young child (age 2-6) and his grasp of reality, it must be pointed out that, unless he is color blind or emotionally disturbed, he KNOWS very well that the colors and proportions in his picture do not correspond in a visually imitative way to the world he sees about him. But he is using a symbolic language—the language of paint on paper, for instance, which has a logic and syntax of its own. When a child exaggerates an object in his picture, it is out of an emotional response to reality. This object was important for him or some one of its qualities especially impressed him. He is calling attention to this fact. For presumptuous adults to demand "correctness" of proportion would reduce this experience and its expression to a lifeless monotony, which has no vital significance to the child in terms of his own personal observations. This leads to a dulling of the child's acute awareness of small details which we adults never notice.

The paint-by-number sets and coloring books, the do-it-yourself manuals are the work of the hovering adult who thinks he has all the answers. This is not in the spirit of Montessori for it does not answer the child's human need to re-create his experiences and communicate them on a symbolic level.

If we could only realize that art (making) is a VERB and not a noun (a finished "correct" object) we might be on the path to applying Montessori's principles intelligently and creatively in this area of activity. We might also wake up to the fact that Art and Science, making and knowing, the hand and the mind, cannot be torn apart, as they have in our culture, without dire results.

To parents and teachers who seem unsure as to what kinds of materials to offer the child so that he has an opportunity to engage in worthwhile art activities, I would first say: Get rid of all paint-by-number sets, coloring books, do-it-yourself mosaic kits (which supply ready-made designs, the consumer does the manual labor), all such exercises and manuals which lead to the consequences outlined above. What materials should be provided? For drawing, painting, collage, potato and mono-printing there are some basic supplies: plain white paper, e.g. newsprint, drawing and construction paper, and an assortment of colored papers; paste or glue; crayons, felt-tip markers, colored chalks and pencils; thick tempera paint (powdered tempera and liquid starch mixed one-to-one, or until it is a creamy, dripless consistency with a dash of liquid detergent for easy cleaning); inexpensive round and flat, "sable" and bristle brushes in a variety of sizes. For modeling, there is clay, plasticene, and papier mache. For work with clay and plasticene, cutting and modeling tools can be improvised from household utensils and gadgets. These are only a few suggestions, but would be a good list to begin with, keeping in mind that the child will advance from one medium to another depending on his physical coordination and his visual conceiving (symbolic stage).

In the child's first stages of art work (age 2-5), the development of a respect for his tools and materials is of great importance. As with the sensorial materials, art supplies should be easily accessible to the child and efficiently stored, i.e., each medium or set of tools in its place. Paint, for instance, should be pre-mixed and given to the child in small, easy to use syrup dispensers so that the child can serve himself. During painting, baby food jars serve as good containers and can be conveniently set into easel trays. Also, for easel painting, a large plastic bucket can be provided for hand and brush wiping at intervals while painting. Needless to say, clean-up afterward should be the child's responsibility. But his ability to do so will depend greatly on the adult's organization of the work space and storage areas and proper instruction in procedures.

If proper storage and work space and appropriate materials are not provided, then all talk of an "art program" in a Montessori school is futile. If art activities lead to a "big mess", then the adults in charge need to examine the environment, and not blame the child's imagined lack of readiness or the "messy nature" of art activities. Art activities are no messier than others IF the environment is properly prepared and IF the activity is properly structured. Proper structuring involves a clear demonstration to the child in the following: where and how to get and return his supplies, where and how to use them, how to clean up the work area and tools and himself. This procedure is certainly not new to Montessorians. Art activities include many standard practical life exercises. It is for this reason that painting, for instance, might well be introduced during this "sensitive period" when the child is strongly attracted to practical life exercises.

A knowledge of stages of development is important. Is the child at the initial stage of manipulation, scribbling and daubing simply to investigate the nature of the particular materials he is using? Or has he advanced to the recognizable symbol, where a circle with two sticks for legs equals a person? Or is he making pictures with symbols featuring more details and the symbols relating to each other? Are the symbols

integrated into an environmental setting to form a unified whole? These are important questions if the adult is to provide the child with the media proper to his stage of visual conceiving. (For a discussion of these stages, with illustrations, see Viktor Lowenfeld's Creative and Mental Growth, pp. 86-277).

Above all, never teach a young child "how to draw". Symbol-making is an innate human characteristic. The child must design his own symbols for himself or his ability to do so will die. Let him experiment. Observe, do not judge him. If he is satisfied with the product, then that is enough. If you are open and observant yourself, you are apt to be delighted with what you discover about this activity and its importance to the child. If we first rid ourselves of the ready-made answers and mechanical skills approach, we will have opened the way to adult understanding and appreciation of the rich, charming and very humorous world of child art. We will open our eyes to what the child has to teach and to reveal to us about himself and about the world - a thoroughly Montessori approach, it would seem.

(Reprint from AMS BULLETIN 1965, Vol.3, No.2)

The following materials and quantities are recommended for a primary class (ages 2½ to 5) of about 20 children. The suggested quantities are minimum supplies. When the supply falls below this, more should be ordered. The best quality art supplies are manufactured by American Crayon Company (Prang) and Milton Bradley. Inferior products are not worth buying, as the colors are dull and do not mix "true" and they do not last as long. Both of these firms put out fully illustrated catalogs which are available from school supply or large stationery firms who distribute these lines. Also, every major city in the U.S. has a sales representative from these manufacturers.

<u>ITEM</u>	<u>QUANTITY</u>
Modeling Clay, plastic	5 lb. bar
Ceramic Clay	25 lb. bag
Play Dough	10 lbs.
Clay Boards, 18" x 24" (masonite)	10
Cookie Cutters (basic geometric shapes)	6 or more
Rolling Pin (small size)	1
Colored Paper, 20" x 30" (Japanese origami-type)	12 sheets
Gummed Paper, assorted colors (Dennisons)	2 pkgs.
Assorted Seals (Dennisons)	5 pkgs.
Poster Paper, 12" x 18"/50 sht. pkg. White Assorted colors	2 pkgs. 1 pkg.
Construction Paper, 12" x 18" White Assorted colors	2 pkgs. 1 pkg.
Tissue Paper (Crystal brand) Assorted colors	24 sheets
Newsprint, unruled 18" x 24"	1 ream
Assortment of special purpose papers (see instruction sheets)	
Colored Pencils, assorted, box of 8	4 boxes
Lead Pencils, extra large diameter	4 doz.
Crayons, 8 or 16 colors, large diam.	12 boxes

Oil Pastels (Guitar brand), 24 colors	1 box
Colored Chalk, assorted, large diameter (Ambrite - American Crayon Company)	1 gross
Chalk, white	24 sticks
Felt Pens, assorted - 8 per box (Magic Marker, Marks-a-lot)	6 sets
Scissors, blunt (rt. & lft. handed) with cushion grip handles	15
Library Paste or Adhezo (Milton Bradley)	1 qt. refill
Wilhold-type Glue	1 pt. refill
Glue Birds for above, 2 or 4 oz.	6
Laundry Starch, liquid concentrated	1 gal.
Paste Brushes	8
Paint Brushes (easel) bristle, flat	
1/4"	4
1/2"	4
3/4"	8
1"	4
Tempera Paint, pint bottles, liquid concentrate (Prang or Milton Bradley) or pound cans, powder (same brands) to mix with liquid starch.	
Red	2 bottles or cans
Yellow	2
Blue	2
Green	1
Orange	1
Violet	1
Magenta	1
Turquoise	1
Black	1
White	1
(Gold & Silver optional)	1
Water Colors, set of 8 large pans includes brush in box (Prang OVL 8)	3
Aluminum rack, for drying paintings (Creative Playthings)	1
Easels, dual with tray	2
Plastic Aprons or Smocks	6 or more

Color Wheel (Milton Bradley) 18x21 wall chart

Fixative for chalk drawings (cheap Hair Spray)

Baby food jars for painting (with lids)

Quart jars (glass) for rinsing brushes while painting

Quart jars for mixing and storing paint

Syrup dispensers for paint storage in classroom

Smocks or plastic aprons for children

Plastic bucket for water (on floor)

Plastic water basin with water - for cleaning paint drips with sponge

Sponges for cleaning up drips and spills

Plastic water pitcher (for replenishing rinse water)

Paper towels for wiping hands and brush (and/or Kleenex)

Coffee can or jar for storing brushes

Plastic floor cover for painting area

Waste basket for throwing soiled paper towels, tissue

Small boxes or trays for displaying materials which are bought in bulk
e.g. chalks, crayons, scissors, etc.

Boxes or baskets for collage collection - "collage boxes"

Box for gadgets - for gadget printing

Box for gadget tools for working with clay

Plastic trays (small and medium) for carrying materials

Clothes pin bag

Clothes pins (for hanging paintings)

Art Materials

CLAY

Types of modeling clay:

Ceramic (wet) clay. "Ceramtex" brand comes in 25 lb. plastic bags.
 Plastic clay. "Plasticene" comes in 1 lb. and 5 lb. prisms.
 Play dough. "Play Dough" brand ready-made or can be home made.

Home-made Play Dough recipe:

3 parts flour
 1 part salt
 $\frac{1}{2}$ part cooking oil
 water (enough for a moldable consistency)
 powder tempera (for bright color)

Tools for modeling:

Rolling Pin (small size)
 Knife (dull table knife or plastic picnic knife)
 Tongue depressor
 Sticks (toothpicks, dowels, plastic cocktail sticks, etc.)
 Cookie Cutters (basic geometric shapes, no "cute" designs)
 Hair Rollers (for cutters)
 Miscellaneous gadgets and construction aids
 Putty Knife (for cleaning work board)

Work Surface:

Masonite boards (18" X 24") smooth on one side only.
 or
 Formica sink cut outs (available at lumber yards or cabinet shops).
 or
 Plywood boards (varnished to prevent splintering) same size as masonite.
 or
 Linoleum mounted on wood or table top.

Note: clay modeling surfaces should be smooth so that the clay does not stick to the surface and can be easily cleaned.

MATERIALS:

1. Clay (modeling substance, e.g. plasticene, play dough)...
2. Plastic air-tight container (for storage of clay).
3. Work board (18" X 24" masonite, wood, etc.).
4. Tray (for carrying materials to work area).
5. Assortment of modeling and cutting tools.
6. Basket (box or tray) for tool storage and display.
7. Rag (turkish towel) for wiping hands.

ARRANGEMENT:

The clay should be displayed in medium size plastic pails or containers which have air-tight lids. This prevents modeling substance from drying out and hardening. If the substance begins to dry out and harden after use, add a bit of water and reseal lid firmly. This need be done only with the water base ceramic clay. Plastic base clay does not dry out as do the water base products. The clay (no matter which type) should always be displayed for the children's use in small palm-sized chunks or balls for ease of accessibility.

An alternative to using portable work boards is to prepare a permanent clay table in the art area. This table could also be used for finger painting and mono-printing. It would have to have a specially prepared top, e.g. formica, linoleum, masonite glued or taped to a wood table top. A display area for clay figures which the children want to save should be provided.

PROCEDURE:

1. Take a masonite clay board and put it on a table in the art area.
2. Take a tray at the clay display shelf in the art area and place selection of materials on it: clay, tools, clean-up putty knife.
3. Take this to the table and work with clay.
4. When finished working with clay, clean the clay board by rolling all excess clay into a ball and scraping clay board clean with putty knife.
5. Clean cutting tools if necessary with damp rag.
6. Return materials to their place, putting left over clay back in clay container and resealing the lid tightly.
7. Return work board to its place.
8. Wash hands.

SUGGESTIONS:

1. Ceramic clay figures can be "fired" in a home oven or can be left out in the sun to dry and harden.
2. Before firing, ceramic clay pieces can be colored by painting with non-toxic ceramic glazes or with tempera paint.
3. Hand print plaques can be made by rolling out a piece of clay pie crust fashion and pressing the full hand into the smooth surface of the clay. The teacher can write the child's name into the clay (or encourage the child to do so). This is especially enjoyable for young children and is often a real ego-booster.
4. Ceramic and mosaic plaques can be made by embedding such things as sea shells, stones, etc. into a rolled out sheet of clay.

Art Materials

DRAWING MATERIALS

Tools:

Pencils (lead or colored) wide diameter "beginner's" or "exercise" width
Felt pens (assorted color sets)
Crayons (wide diameter)
Colored chalks
Pastels
Oil pastels
Stick or twig (dipped in tempera)
Chinese pointed brush (dipped in tempera or water color)

Paper:

Plain newsprint (with chalk, pencil, pastel, oil pastel, crayons)
Construction paper (same as above, also with all other tools on list)
Poster paper (same as above, also with all other tools on list)
Drawing paper (with stick, Chinese brush, felt pens, pencils, crayons)
Butcher paper (with stick, Chinese brush, felt pens, pencils, crayons)
Brown Kraft paper (with crayons, chalks, stick, Chinese brush, felt pens)
Shelf paper (with pencils, felt pens, crayons, stick, Chinese brush)
Charcoal paper (with crayons, pastel, chalks, oil pastel)
Oatmeal paper (with chalks, pastel, oil pastel, crayons, felt pens)
Wax paper (with felt pens)
Printer's paper (texture will determine most appropriate tools)
Fabric (with felt pens)
Wall paper
Wrapping paper
Rice paper
No seam photographer's backdrop paper (with felt pens, chalks, stick, Chinese brush, crayons)

Fixatives:

Fixatives should be used with such materials as chalk and pastel to prevent the drawing from rubbing off. If a spray fixative is used it should be done by the teacher in a separate area. These fixatives are usually toxic and should be used with every precaution, regarding children and environment. Newspaper should always be spread out under the drawings to be sprayed. Always follow the directions on the spray can. Artist's fixatives are available in art or draughting supply stores.

Clear fixative (e.g. Krylon Crystal Clear) in spray can
Hair spray (in spray can) any inexpensive brand will do
Liquid laundry starch (must be brushed on with water color brush; can be done by the child - he simply brushes starch over the chalk or pastel drawing, washing brush out each time the chalk color changes)

Art Materials

WATER COLORS

Paints:

Water color sets of assorted colors are recommended. These sets come in metal boxes with individual refillable paint pans. The Prang OVL-8 set of 8 colors (primaries, secondaries, black & brown) or any comparable set is good. The pans should be large (full pans) and the box should have a slot along one side for brush storage. The above mentioned set has all of these features. Water colors can also be made by mixing water and detergent with powdered tempera, but this can be very drippy and difficult to control.

Brushes:

Water color brushes differ from the easel brushes used with tempera paint. Water color brushes are round and are made of soft hair rather than stiff bristles. The soft, round brush "holds" the water better (does not drip as freely) and is therefore more manageable. The straight, flat bristle brush is stiff and therefore the water drips right off the brush. This is good for thick paint substances (such as tempera, casein and oil paints) but not for paints of a watery consistency. Large water color wash brushes with a fat brush are good for either water colors or tempera, and can be used to achieve very interesting effects.

Paper:

Water colors must be used on absorbent papers. They will not adhere to waxy or slick surfaces. Some good water color papers are the following:

- Plain newsprint
- Construction paper (white or colored) 9" X 12", 12" X 18", 18" X 24"
- Poster paper (white or colored - same sizes as construction paper)
- Drawing paper
- Oatmeal paper
- Rice paper
- No-seam (photo backdrop paper which comes in large rolls and can be cut up)
- Printer's paper (left-over ends available free at printing shops)
- Water color painting paper (expensive)
- Cardboard (white shirt cardboard)

WATER COLOR PAINTING

MATERIALS:

1. Water color paint set
(individual pans in metal box - oval full pan e.g. Prang brand)
colors: red, yellow, blue, green, violet, orange, black, brown
2. Water color brush
3. Quart size jar (for washing brush)
4. Paper (newsprint or other appropriate paper)
5. Apron or smock
6. Clean up materials as used in painting at the easel:
pitcher, small basin, sponge, bucket, paper towels
(the clean up materials provided in the easel area can be used
for this activity so that another set of materials is not necessary.)

ARRANGEMENT:

The water color sets (about 3 per 15 children) should be displayed in the art area near the tempera paint materials. Water color painting is usually done at a table and this table should be in the general art area as the easel painting clean up materials will be needed for this type of painting too. Cleaning the water color table is a good practical life (table washing) activity and the table washing materials should be used for this purpose.

PROCEDURE:

Note: This is a very good way to introduce the painting process to a child who has never painted before or even seen anyone paint before. The materials are simple and fairly easy to manage and provide a good opportunity for discovering what painting and cleaning a brush is all about.

1. Put plastic apron or smock on.
2. Select a paint set (brush should be in the paint box slot provided for that purpose) and take it to the art table.
3. Get a quart size water jar and take it to the table.
4. Get the water pitcher from the art utility table between the easels and fill the quart jar half full. Return the pitcher to its place.
5. Get a piece of art paper and put it on the table.
6. Wet brush in water, wiping excess water off on lip of jar.
7. Wipe brush on paint pan surface, getting plenty of paint onto the brush.
8. Apply paint to paper, being sure to get more paint on brush when the brush becomes dry.
9. When new color is desired, wash brush in water jar by immersing the brush part only and not the handle, and wipe the brush on the lip of the jar to remove excess water before getting paint from a paint pan.
10. Continue until finished painting, washing the brush thoroughly before returning it to the paint box. (the brush should also be wiped with a paper towel to completely remove excess paint and water before being put back in box.)
11. Return materials to their place in the art display area.
12. Dump wash water out in dirty water bucket in art area, and return jar to its place.
13. Hang painting up (if not too drippy) on painting rack to dry.
14. Wash table top clean with sponge (and soap, if necessary) and dry it off.
15. Return apron or smock to its place.

Art Materials

TEMPERA PAINT

Powder Tempera

Recipe: 1 part powder tempera
 1 part liquid laundry starch
 1 dash liquid detergent (about 2 tablespoons per quart)

Measure the powder tempera into a large jar. Pour the liquid starch over the powder tempera and add a dash of detergent. Screw the lid tightly on the jar and shake well to mix contents thoroughly.

Add more tempera if color seems washed out. Add more starch if consistency seems too thick. Desired consistency: smooth & creamy, avoid thin, runny paint as it drips, is messy & hard to control.

Liquid Tempera (concentrated)

Recipe: Add liquid laundry starch to the concentrated liquid tempera to achieve a creamy consistency as described above. Add a dash of liquid detergent

Use: Easel Painting
 Mural Painting
 Finger Painting (mixed extra thick)
 Vegetable Printing (carrots, potatoes, turnips, etc.)
 Gadget Printing (sponge, cork, metal parts, etc.)
 Mono-printing
 With Collage
 Decoration on 3-d item (wood, cardboard, papier mache, etc.)
 Crayon Resist (mixed very thin to water color consistency)
 Oil Pastel Resist (used same as in crayon resist)
 Drawing (with twig, stick, etc.)

Paper: Plain Newsprint (18 x 24 for easel painting)
 Printed Newspaper
 Construction Paper (expensive) 9 x 12, 12 x 18, 18 x 24
 Poster Paper
 Cardboard (plain, corrugated, shirt cardboard)
 Drawing Paper
 Butcher Paper
 Brown Wrap Kraft Paper
 Shelf Paper (slick surface type good for finger painting)
 Finger Painting Paper
 Wax Paper (good for finger painting) mono-printing)
 Aluminum Foil (for finger painting mono-printing)
 Gift Wrap Paper
 Printer's Paper (left over ends or strips-free at printing shops)
 Miscellaneous Textured & Colored Papers
 Fabric Scraps (for banners & flags (felt, pelon, cotton, flannel, etc.)

PAINTING (first presentation)

At The Table

This presentation of the painting medium is intended for very young children or disadvantaged children whose limited experiences have not included the observation of others engaging in painting activities. For this reason, this presentation is very detailed and methodical.

MATERIALS:

1. Plastic apron or smock
2. Art paper (see TEMPERA PAINT, Paper)
3. Tray
4. Quart size jar
5. One baby food jar half filled with thick tempera paint
6. One brush (#6 Delta water color wash brush or #8 flat easel brush)
7. Pitcher of water (on utility table at easel area)
8. Bucket (at easel area)
9. Table washing materials (practical life area)
10. Paper towels

ARRANGEMENT:

These are the same materials as those used in PAINTING at the easel and should be displayed in the same shelf area. The child takes the tray and on it places the following: water jar (empty), paint jar (filled), brush, and paper towels.

PROCEDURE:

1. Set the tray down on the right hand side of the art paper at the table.
2. Get the water pitcher in the art area and fill the water jar ($\frac{1}{2}$ to $\frac{3}{4}$ full).
3. Uncap the paint jar and lay the cap (inside facing up) next to the jar.
4. Pick up the brush, gripping it a little above the metal band above the bristles. (Children sometimes hold it at the end of the handle which makes the brush more difficult to control.)
5. Dip the brush ($\frac{3}{4}$ of the bristles submerged) into the water.
6. Hold the brush just above the mouth of the jar to show how the water drips from the brush.
7. Wipe brush on lip of jar to remove excess water.
8. Hold brush up again to show "no more dripping."
9. Invite the child to repeat dipping the brush.
10. Dip the brush into the paint, using the same procedure as outlined above with the water, being careful to wipe excess paint on lip of jar.
11. The child is now ready to paint on his paper. Allow him freedom to discover this process for himself. If his brush becomes too dry, it may be necessary to encourage him to get more paint on his brush.
12. When he is finished painting, show him how to clean his brush.

(Cleaning the brush.)

13. Dip brush into water (up to the point where the bristle meets the metal

- part of the handle). Always avoid getting water on the handle itself as this is the cause of dripping of water or paint down the arm when the brush is raised again into painting position (in easel painting).
14. Swish the brush about in the water, drawing the child's attention to the change of color that takes place in the water.
 15. Hold the brush above the mouth of the water jar. If the drips are dark in color, the brush needs more rinsing.
 16. When the brush is clean (very light colored or clear water drips) wipe the brush on the lip of the jar and wipe with paper towel to dry. This is an extra cleaning check, too, for if paint shows on the paper towel, that means the brush is not clean.
 17. When brush is thoroughly clean, return to tray.
 18. Hang painting on painting rack.
 19. Wash and dry table and tray if necessary, dumping dirty rinse water out in bucket.
 20. Return materials to their proper places in the art display area.
 21. Check once again for any spills on floor or table.

LATER EXERCISES:

1. Present child with two colors (contrasting, e.g. red and blue) to provide practice in cleaning a brush, so as not to contaminate the second color. Then give him three colors (the primaries) and so on.
2. As a preparation for painting for very, very young children (2 to 2½), sets are available featuring a paper which colors when it is painted on with a brush wet with water only.
3. Water color sets may also be used for first presentations (Prang OVL-8).

MATERIALS: (for 4 children)

1. Two double easels with paint trays
2. Eight clothespins (for securing paper to easel board) 2 per child
3. Utility table (20" h x 24 x 36)
4. Four Quart Size Jars (for washing brushes) 1 per child
5. One Pitcher
6. One Small Basin (for water and sponges)
7. Three or Four Large Sponges (for wiping up spills)
8. One or Two Buckets (for dumping dirty water)
9. Paper Towels
10. Plastic Floor Cover for under easel area
11. Aprons or Smocks
12. Tempera Paint (stored in small jars with lids/kept on nearby shelf)
13. Paint Brushes (stored on nearby shelf, standing bristle up in can or jar)
14. Paper (plain newsprint, butcher paper, etc., 18 x 24)

ARRANGEMENT:

The utility table should be between the two easels so that all four children can use the table. The short end of the table would be facing out with the easels along the long sides of the table. The basin, sponges and water pitcher are in the center of the utility table for all four children to use. The basin should have a small amount of water in the bottom for moistening the sponges. The sponges are for wiping up spills of paint as they might occur. The pitcher should be half full of water for refilling the water in the quart jars as it gets dirty. The bucket (for dirty water) is on the floor at the short end of the utility table. If there are two buckets one can be placed at each end of the table to be shared by two children. The utility table should be covered with plastic or oil cloth if it does not have a special surface already, e.g. formica or linoleum. There should be two stacks of paper towels, one on each end of the utility table, for two children to share.

PROCEDURE:

Note: The child should transfer small paint jars and brushes to his place at the easel by using a small tray provided for that purpose on the paint display shelf. He should use a maximum of three brushes (one of each size) but he should only use one brush at a time, i.e. when he is not actually painting with a brush it should be cleaned and resting on a piece of paper towel at his area on the utility table. He should not leave brushes standing in the paint jars. This ruins brushes and it causes accidents. These brushes are very easy to brush against and knock onto the floor when they are standing upright in paint jars at the easel. Also, children should not walk around the room or art area with paint-laden brushes. This is very messy.

1. Wet brush in water, wiping excess water off on lip of jar.
2. Dip brush, bristle part only, in paint and apply to paper. (Avoid getting paint on metal part of handle above bristles as this causes dripping.)
3. Continue until a change of colors is desired, then clean brush by immersing the full bristle part into the water jar and wiping excess water on lip of jar. Continue, being sure to clean brushes thoroughly when finished painting, drying them on paper towel. Wipe up all spills with sponge and dry with paper towel. Clean apron and return all materials.

Art Materials

COLLAGE

Adhesives:

Wilhold (or any milk glue) in 2 or 4 oz. plastic dispenser bottles
Liquid laundry starch with Wilhold glue added (in baby food jars)
Library paste (in baby food jars)
Adhezo paste (Milton Bradley, mfg.)
Lepage's glue (micilage) in rubber-tipped dispenser

Adhesive Applicators:

Paste brush
Soft water color brush (for starch glue)
Sponge letter moistener (plastic tube) for gluing gummed papers

Papers:

See "Paper" under TEMPERA PAINT for work sheet paper

Collage Materials:

Colored tissue paper
White tissue paper (for use on colored art paper)
Gift wrapping paper
Japanese origami paper
Rice paper
Cellophane paper (Saran Wrap)
Metallic paper
Gummed colored paper (Dennison, mfg.)
Gummed seals (flowers, birds, notary seals, etc. - Dennison, mfg.)
Magazine paper (from LIFE, LOOK, POST, MCCALL'S, etc. - colors, textures, patterns, objects, people, nature)
Wall paper
Shelf paper
Contact paper
Miscellaneous objects and materials
Gadgets
String
Cloth
Ribbon
Wood
Cotton balls
Cardboard
Leaves
Seeds
Weeds
Dried flowers

Note: These paper materials should be displayed in baskets or boxes according to the type of material (paper in one box, gadgets in another, nature materials in another box).

Cutting On A Line

MATERIALS:

1. Small tray
2. Blunt-nose scissors (right or left-handed)
3. Paper on which pre-drawn geometric shape appears (triangle inset)

PROCEDURE:

1. Pick up paper with left hand.
2. Pick up scissors in right hand and slowly cut along pre-drawn line. Scraps may fall onto tray and remain until materials are put away.
3. When cutting is done, place scissors and scraps on tray.
4. Put scraps into wastebasket, return scissors to scissor basket and return tray to shelf.
5. Cut-out shape may be kept or put into the collage box in art area.

VARIATIONS AND TIPS:

1. Provide pieces of wide-line primary paper to cut (following the lines).
2. Provide interesting magazines which have good pictures to cut out.
3. Encourage child to cut out the various geometric shapes which he has drawn using the metal insets.
4. Encourage the child to cut shapes out of miscellaneous materials, e.g. cloth for use in collages.

Cutting Spirals

MATERIALS:

Same as above, with the exception of the paper. Provide a circle (5" or more in diameter).

PROCEDURE:

1. Pick up scissors with right hand, paper with left.
2. Slowly cut around and around from the outside edge toward the center keeping the cut strip an equal width throughout.
3. When the cutting is finished, take the two ends in hand, putting the spiral shaped strip into a 3-dimensional (conical) spiral.
4. After returning materials place paper scraps in wastebasket and sweep floor if necessary.

VARIATIONS:

1. As preparation, have child cut circular inset drawings, e.g. circle, oval, ellipse, quatrefoil, etc.
2. Graduate to more complicated cutting, e.g. snowflake patterns out of folded squares or paper napkins.

PASTING GUMMED PAPER

MATERIALS:

1. Small tray (for carrying materials to table).
2. Small pieces of pre-cut colored paper with gummed back (Dennison).
3. Large sheet of plain paper.
4. Sponge moistener (plastic water bottle with sponge on lid)
or
small, moist sponge in a furniture coaster.
5. Small plastic mat.
6. Small damp rag.

PROCEDURE:

1. Place plastic mat to the right of the large art paper, in front of the tray.
2. Pick up one of the small pre-cut pieces of gummed paper from the tray and place it on the mat gummed side up.
3. Hold the paper down with the left hand and pick up the sponge moistener with the right hand.
4. Carefully wipe the sponge across the gummed surface. Return moistener to tray.
5. Pick up the piece of gummed paper, turn it over with the colored side up and gently lay it down on the art paper, rubbing the surface with the finger tips to make it stick down securely.
6. Wipe fingers if they get too sticky, using damp rag or another sponge designated for that purpose.

VARIATIONS:

1. Provide pre-cut geometric shapes, seals (flowers, birds, butterflies, etc., also notary seals, hearts).
2. Provide brown kraft tape in rolls, plus other types of tape, e.g. colored or clear cellophane tape.

PASTING (2)

MATERIALS:

1. Small tray.
2. Small jar of library paste or Adhezo Paste.
3. Paste brush.
4. Large piece of art paper.
5. Smaller pre-cut pieces of colored paper (from COLLAGE BOX)
6. Plastic mat.
7. Small damp rag.

PROCEDURE:

1. Place plastic mat to the right of the art paper, in front of tray.
2. Place small collage paper on mat, back side up.
3. Put paste on paste brush by dipping the bristles only into paste and then brush the paste on the collage paper, being sure to hold the small paper securely with the left hand.
4. When collage paper has an even, thin coat of paste all over it, pick it up, turn it over and place it on the art paper.
5. Rub small paper gently to secure it firmly to art paper.
6. Use small damp rag to remove excess paste from fingers.
7. Also be sure to clean up excess paste from plastic mat.

VARIATIONS:

1. Provide white milk glue (Wilhold-type) in small 2 or 4 oz. plastic dispensers.
2. Provide varieties of materials for collage keeping them in separate boxes.
3. Provide dowels, toothpicks, cardboard, etc. for gluing 3-dimensional constructions.

MIXED MEDIA

CRAYON RESIST

MATERIALS: Crayons and water colors (or diluted tempera)

PROCEDURE: Make a crayon drawing on heavy, absorbent paper using maximum pressure so the drawing is very waxy. Paint with water colors over the drawing. As water and wax will not mix, the water color will not cover the wax drawing but will only stick to the absorbent paper. The drawing will show through the painting giving interesting textural and color effects.

OIL PASTEL RESIST

MATERIALS: Oil pastel and water colors (or diluted tempera)

PROCEDURE: Same as crayon resist.

CHALK & STARCH PAINTING

MATERIALS: Chalk (or pastel), liquid laundry starch, & watercolor brush.

PROCEDURE: Make a drawing with colored chalks or pastels. Paint with liquid laundry starch over the drawing. Wash the brush out each time the color of the chalk changes if clean colors are to be maintained. Overlay colors can be achieved (one color on top of another) by not washing the brush between chalk colors but allowing the colors to blend together.

OTHER MEDIA COMBINATIONS

COLLAGE - TEMPERA PAINT

COLLAGE - WATER COLOR PAINT

COLLAGE - DRAWING

COLLAGE - DRAWING - PAINTING

CHALK DRAWING - PAINTING

FELT PEN DRAWING - PAINTING

FELT PEN DRAWING - TISSUE PAPER COLLAGE

STARCH OR TEMPERA PAINTING - TISSUE PAPER COLLAGE (directly onto wet painting)

ART MATERIALS

Finger Paint

FINGER PAINT:

Commercially produced finger paints can be purchased. They come pre-mixed or can be mixed with a combination of tempera paint and special bases.

or

The liquid starch and tempera mixture (mixed very thick) can be used for finger painting. See TEMPERA PAINT for recipe.

USE:

Finger Painting
Mono Printing

PAPER OR WORK SURFACE:

Finger paint paper
Butcher paper (shiny side)
Contact paper (adhered to plywood board)
Aluminum foil (stretched over cardboard & taped to back side)
Shelf paper (slick, plastic coated)
Plastic fabric or oil-cloth surface (on board)
Cookie sheet
Masonite (smooth side) see CLAY - Work Surface
Wooden board (highly varnished with marine or spar varnish)
Formica sink cut out
Linoleum or asphalt tile (on wood)

Note: Hard, smooth surface are best for both finger painting and mono printing.

FINGER PAINTING

Mono-Printing

MATERIALS:

1. Portable work surface (e.g. masonite, formica, etc.)
2. Plastic apron or smock.
3. Tray.
4. Finger paint in small jars (baby food size).
5. Teaspoon.
6. Small wallpaper brush or soft-bristled hand broom
or
rubber brayer.
7. Paper towels (may be in nearby wall holder).
8. Large Sponge.
9. Bucket or water.
10. Hand washing materials (see PRACTICAL LIFE - Hand Washing).
11. Newsprint (same size as printing area) only if mono printing is done.

PROCEDURE:

1. Take tray and on it put: finger paint, spoon, brush or brayer.
2. Take this to the work surface or area.
3. Get the bucket of water with sponge in it and take this to work area.
4. Take teaspoon and spoon some finger paint onto the center of the work surface.
5. Return paint to tray.
6. Using palm of hands, spread the paint out onto the work surface.
If the work surface has no raised edges, do not work the paint out all the way to the edges.
7. Using fingertips, make line drawings into the paint.
8. Rinse hands in bucket and dry on paper towel when finished.

MONO-PRINTING:

1. Take a sheet of newsprint (or other absorbent paper).
2. Lay the paper flat down onto the painting, being careful not to let the paper slide around as this will mess up the painting and obscure the design.
3. With brush or brayer or palm of hand, rub the entire surface of the paper.
4. With one hand at each of the farthest corners (away from self) pick up the paper carefully with arms straight forward away from the body and place the paper on the painting rack.
5. Return to table and wash painting surface off with sponge.
6. Clean floor if necessary, also the tray and table.
7. Wash spoon out in bucket of water and dry with paper towel, also drying up any water in the area.
8. Return all materials.

Note: For first presentation finger painting itself is probably enough and can end at step 8 above. Finger painting is an excellent outdoor activity and provides the same kind of "messaging" experience as do sand and water play. Finger paint is best when it is very thick.

ART MATERIALS

STAMP PRINTING MATERIALS

Printing tools:

Vegetable stamps (cut up pieces of carrot, potato, turnip)
Bottle stopper (corks, pill bottle tops, etc.)
Small sponges (mounted on wood handles)
Wood dowels (cut in short lengths)
Miscellaneous gadgets
Objects from nature (flowers, leaves - apply paint with brush)
Textured materials (fabrics, wood)
Rubber erasers (cut in stamp-size pieces)
Rubber stamp letters, numbers, etc. (commercially made, available at toy stores)

Stamp pads:

Commercial stamp pad (sponge type uninked) with tempera paint added.
Home-made stamp pad (paint soaked sponge set in a small, plastic utility box.)
Paint pan (paint poured in to cover just the bottom of a coaster or tray)

Paper:

Plain newsprint
Construction paper
Poster paper
Cardboard
Oatmeal paper
Drawing paper
Butcher paper
Wrapping paper
Kraft paper
Wall paper
Origami paper
Printer's paper (left over ends)
Paper towels
Pelon or fabric scraps
Miscellaneous absorbent papers

STAMP PRINTING

MATERIALS:

1. Apron or smock
2. Medium size tray and glass furniture coasters (for holding stamps)
or
T.V. dinner tray (with sections or compartments)
3. Stamp pad (sponge type) with paint in it
4. Printing tools (stored in plastic boxes)
5. Art paper
6. Clean up materials as used in painting at the easel:
pitcher, small basin, sponge, bucket, paper towels and "table washing"
materials, if necessary.

ARRANGEMENT:

Printing materials should be displayed near the painting materials.
Printing tools should be displayed in plastic boxes, with a box for
each type of tool, e.g. vegetables in one box, rubber stamps in
another, gadgets in another.

PROCEDURE:

1. Take a tray and some furniture coasters (or T.V. dinner tray.)
2. Select some printing tools and put them in a coaster (or tray section.)
3. Select a stamp pad and put it on the tray.
4. Take the tray to the art table.
5. Get some art paper and take it to the table.
6. Pick up a printing tool by its "handle" or clean end. (A cork is
a good beginning tool.)
7. Stamp the printing end into the stamp pad, stamping 2 or 3 times
in order to get enough paint on the stamp.
8. Stamp with the tool flat onto the art paper, pressing down to get
a good imprint.
9. Lift up the tool "straight" so as not to smear the imprint.
10. Get more paint on the stamp and continue trying various effects
and colors.
11. When finished and ready to return tools, clean the stamps by stamping
with them repeatedly on a paper towel until the paint is gone from
the tool.
12. Lay the stamps out on the paper towel and sponge out the coaster or
tray section that they were sitting in.
13. Return tray (which has been cleaned) and materials to the display area.
14. Hang picture up on painting rack.
15. Clean table top with sponge and water (and soap, if necessary.)

SENSORIAL EXERCISES

by

RUTH WOOD OBOLENSKY

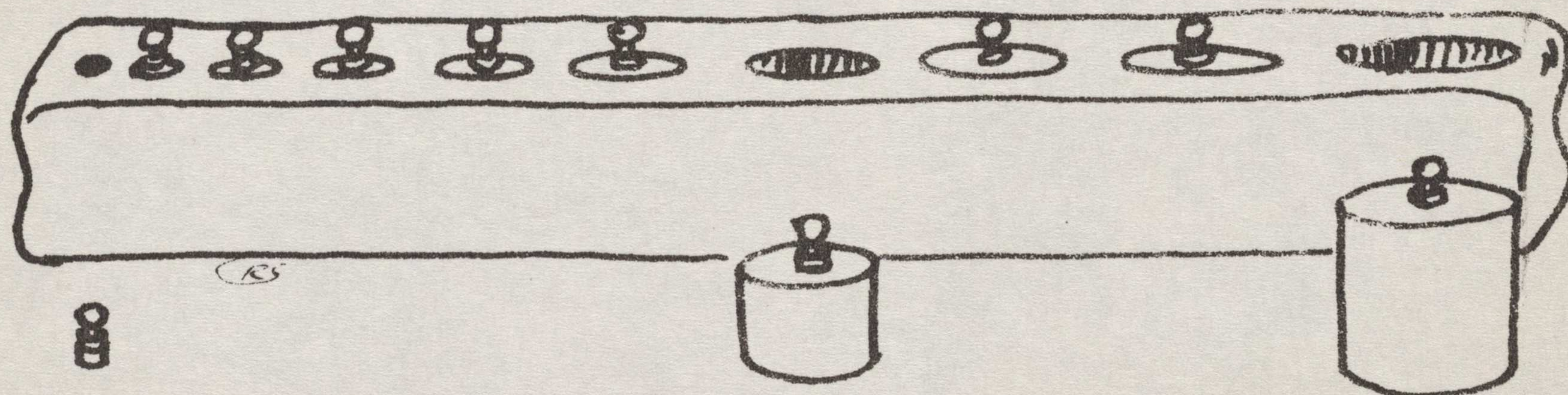
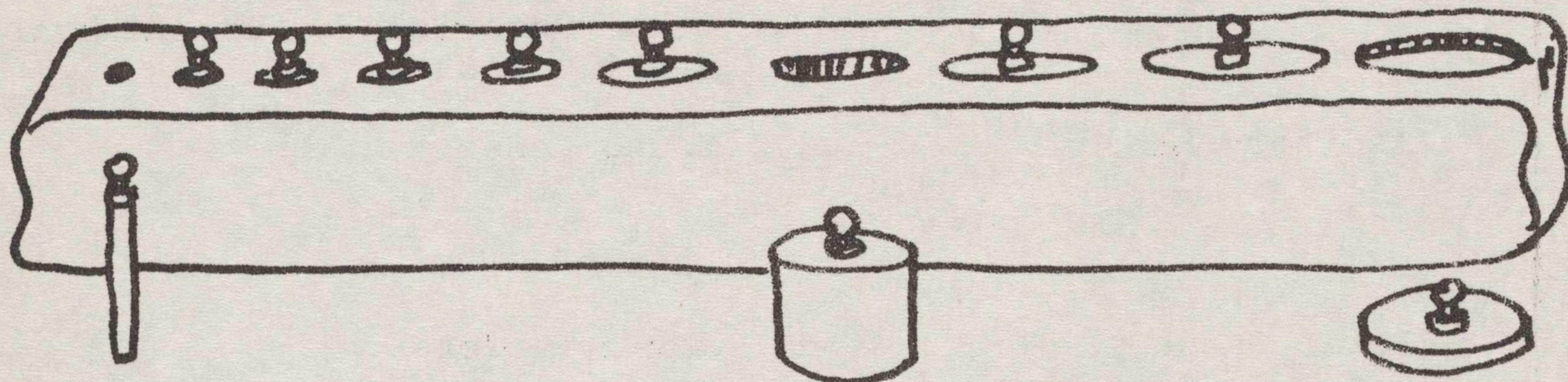
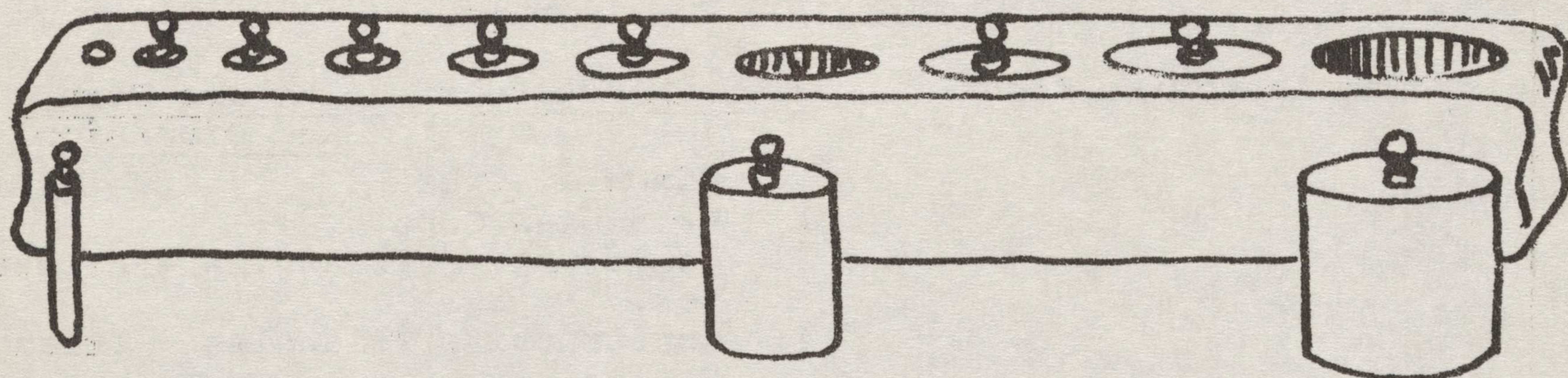
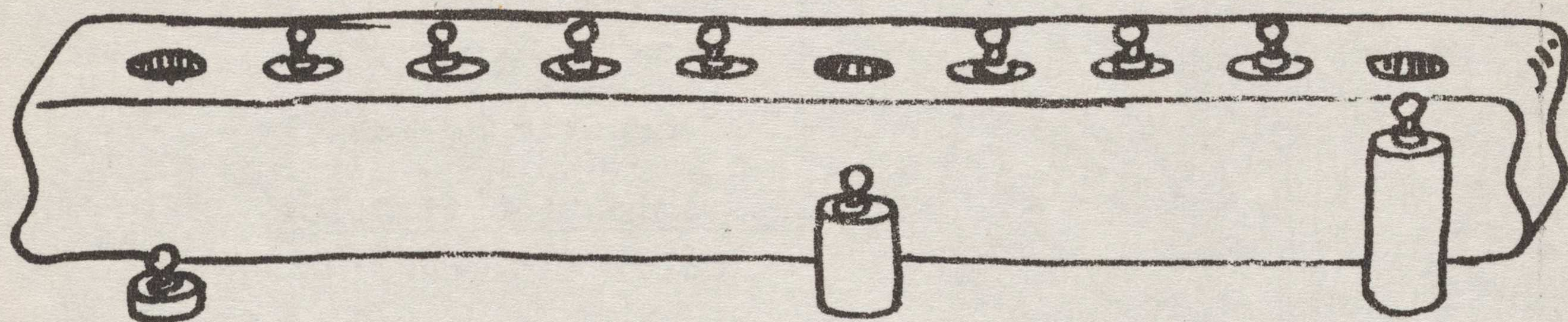
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Robert Savoye
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SENSORIAL MATERIAL

- | | |
|---------------------|--|
| Sense of Sight | <p>A. <u>Discrimination of Dimension and Form</u></p> <ol style="list-style-type: none"> 1. Cylinder Insets 2. Knobless Cylinders 3. Pink Tower 4. Brown Stair 5. Red Rods 6. Geometric Solids <p>B. <u>Discrimination of Color</u></p> <ol style="list-style-type: none"> 1. Color Tablets <p>C. <u>Discrimination of Shape</u></p> <ol style="list-style-type: none"> 1. Geometric Cabinet 2. Biology Cabinet 3. Puzzle Maps |
| Combinatorial Sight | <p><u>Discrimination of Color and Form, Color and Dimension</u></p> <ol style="list-style-type: none"> 1. Binomial Cube 2. Trinomial Cube 3. Constructive Triangles - Rectangular Box. 4. Constructive Triangles - Triangular Box |
| Tactile Sense | <ol style="list-style-type: none"> 1. Rough and Smooth Boards 2. Other Material for Training the Tactile Sense. |
| Auditory Sense | <ol style="list-style-type: none"> 1. Sound Bones <p>2 BELLS</p> |
| Baric Sense | <ol style="list-style-type: none"> 1. Baric Tablets |
| Stereognostic Sense | <ol style="list-style-type: none"> 1. Stereognostic Exercises |

Cylinder Insets



CYLINDER INSETS

MATERIAL

Four blocks, each containing ten cylinders with knobs, with each cylinder fitting into its respective hole in a given block. The four blocks, each with its appropriate series of cylinder insets, form the following gradation of exercises - from easy to difficult.

1. Cylinder insets decreasing in diameter, but of the same height.
2. Cylinder insets varying in both dimensions -
 - a) cylinders vary from the wide diameter and little height to narrow diameter and great height;
 - b) cylinders vary from wide diameter and great height to narrow diameter and little height.
3. Cylinder insets decrease in height, with diameter constant.

DIRECT AIM - Visual discrimination of size.

INDIRECT AIM - Preparation for writing - holding the pencil.

PRESENTATION

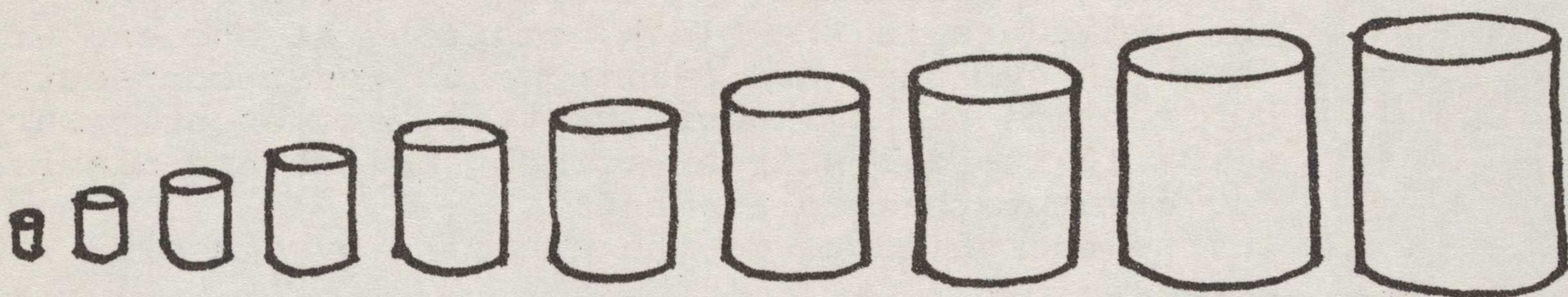
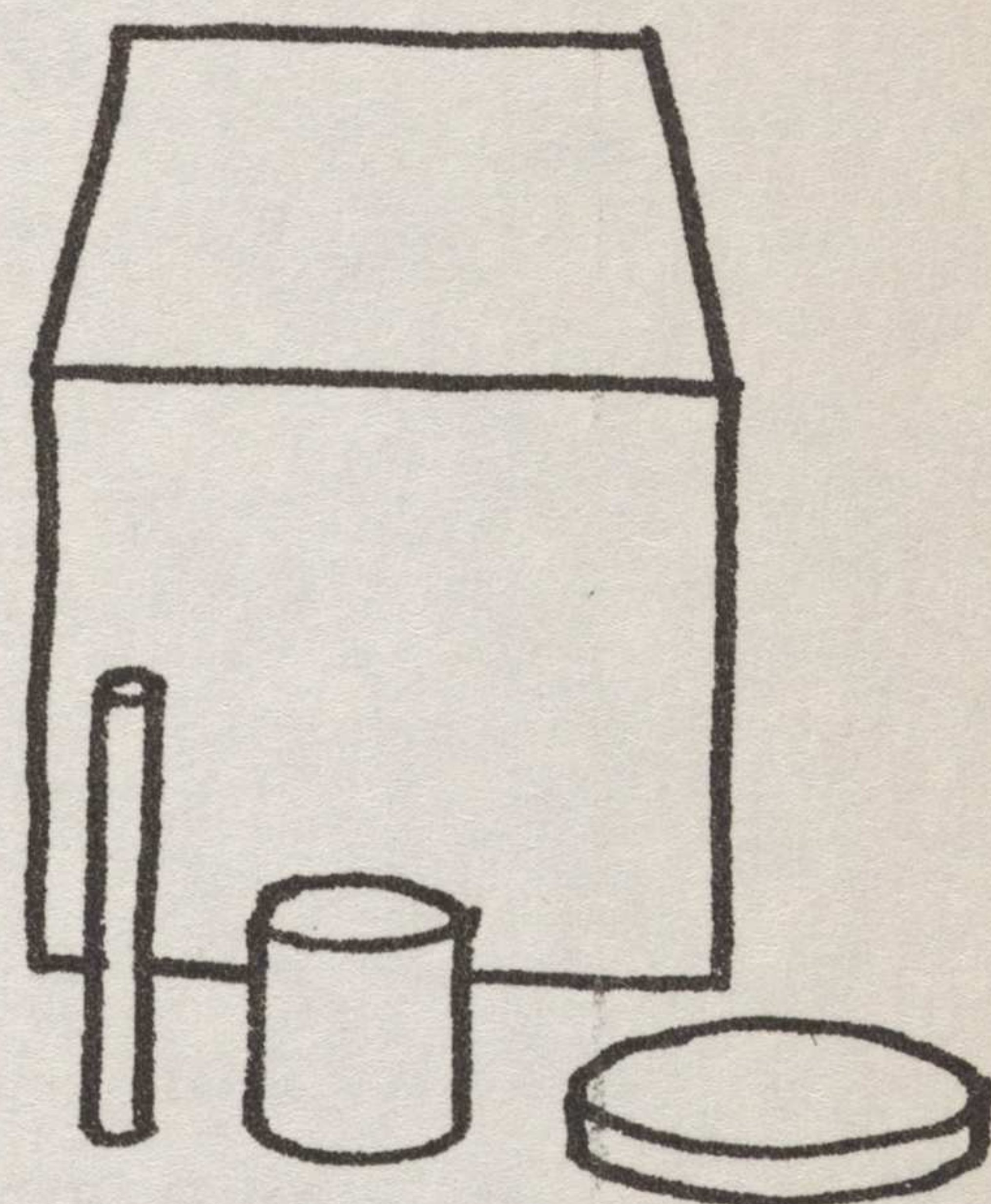
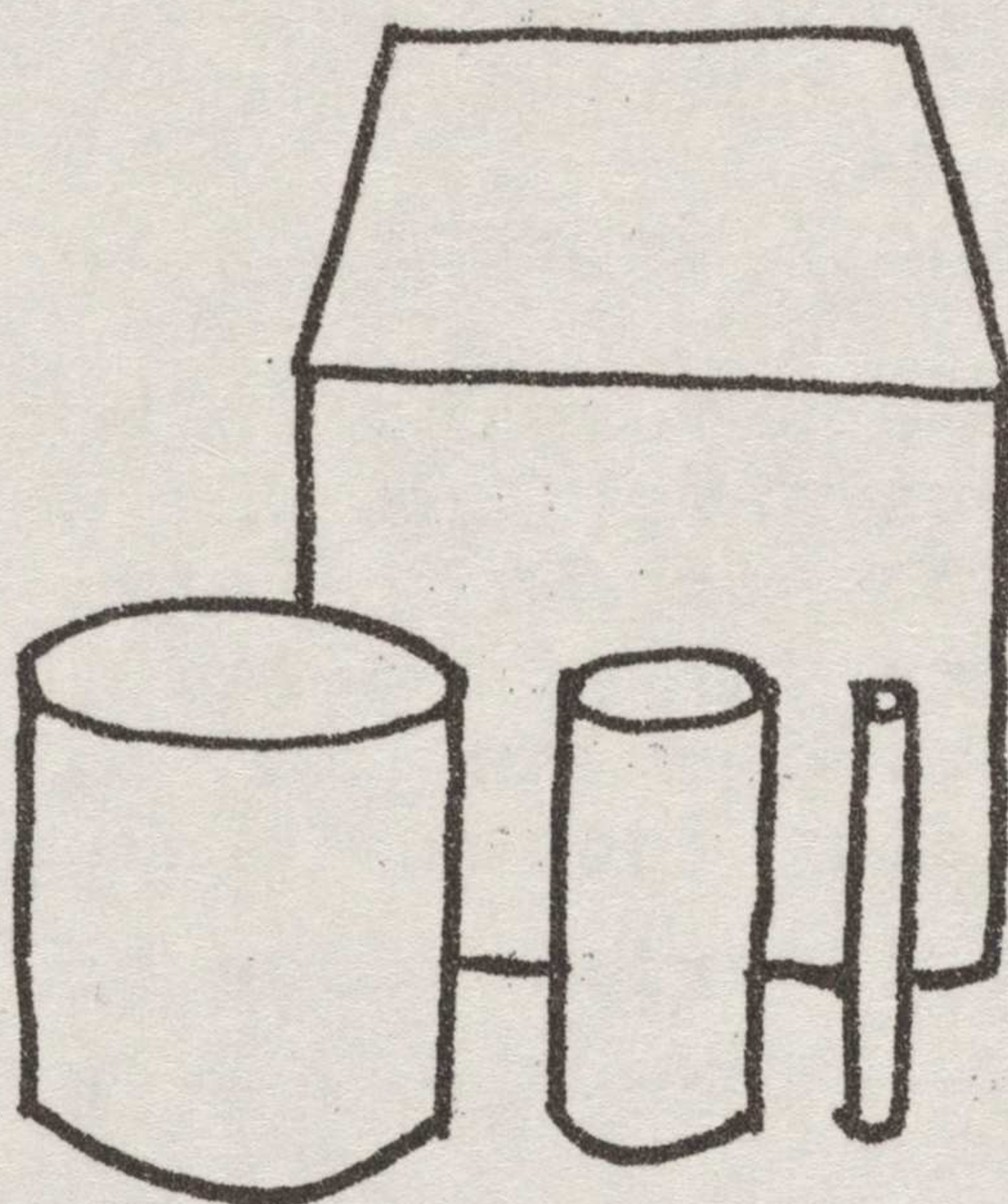
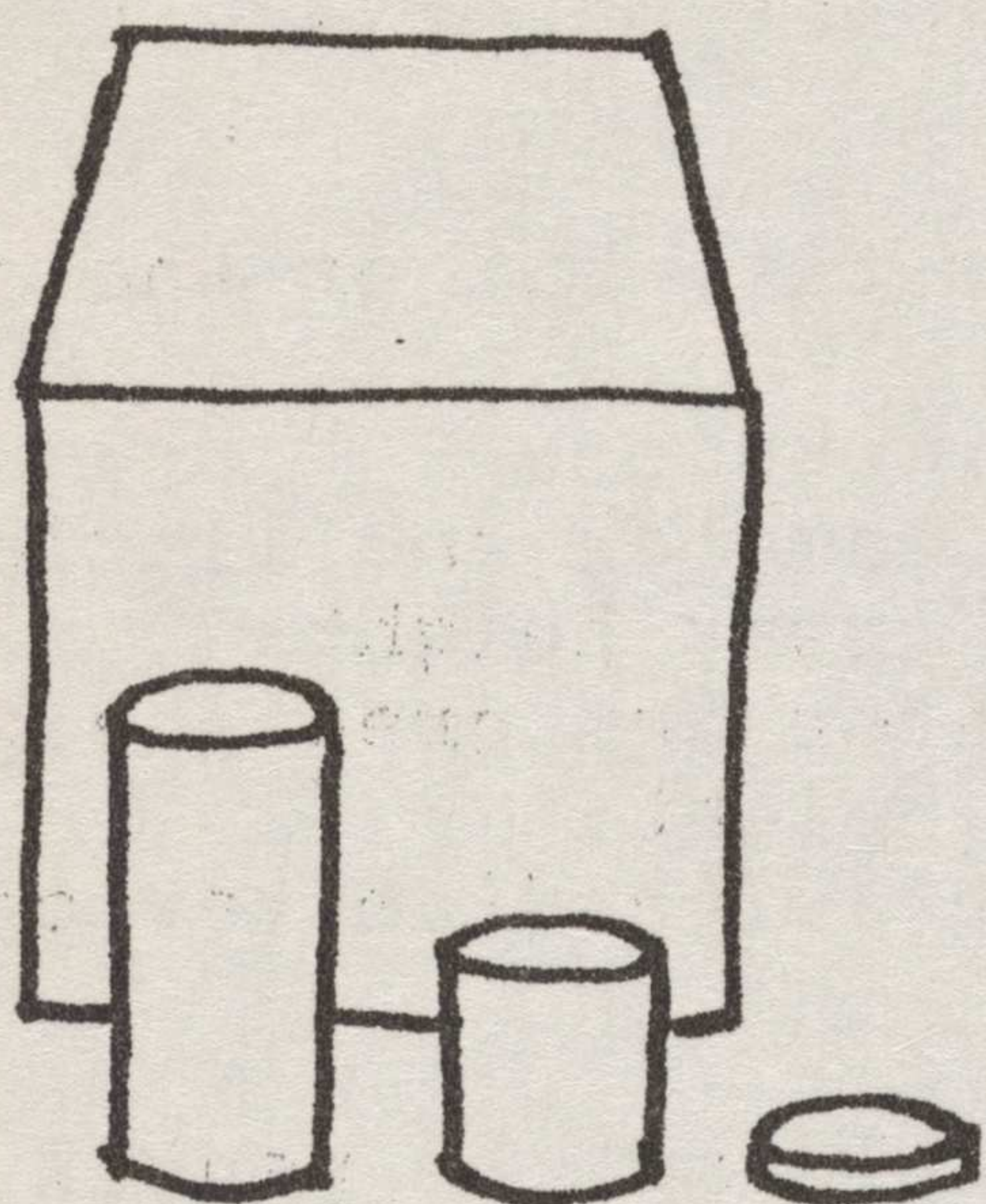
1. Show the child how to carry a block by holding it at both ends. Select block, numbered (1), above, and place it on a table.
2. Remove all cylinders from the insets in the block, showing the child how each knob is to be held between thumb and index and middle finger. Place the cylinders on the table, in mixed order, between yourself and the block. Now replace the cylinders in the block, starting at one end with the thinnest cylinder and filling each inset consecutively. Do not replace the cylinders by trial and error. Rather, select visually the cylinder of correct height and diameter before you attempt the replacement.
3. Invite the child to do the exercise by himself.

LATER EXERCISES

1. Use the other three blocks in the same manner as described for block (1) above.
2. Introduce language as follows:
 - for block (1) - THICK, THIN
 - for block (2) - WIDE, NARROW
 - for block (3) - BIG, SMALL
 - for block (4) - TALL, SHORT
 - for holes ----- DEEP, SHALLOW
 Give comparatives and superlatives for each pair of adjectives that is used.
3. Place two blocks on the table in the form of an inverted V. The cylinders are set out inside the V.
4. Form a triangle out of three of the blocks. Cylinders are set out inside the triangle.
5. Form a square with the four blocks. Cylinders are set out inside the square.

AGE From 2-1/2 to 3-1/2 years.

CONTROL OF ERROR - In the material itself.



Knobless Cylinders

KNOBLESS CYLINDERS

MATERIAL

Four boxes, each containing a set of cylinders, with the same dimension characteristics as the cylinder insets. The sets are of the following colors: set (1) is blue, set (2) yellow, set (3) is orange, and set (4) green.

DIRECT AIM

To compare sets of cylinders that differ in dimensions.

INDIRECT AIM

To obtain clearer ideas about dimensions and their interplay.

PRESENTATION

1. Select a set of cylinders that differ in both height and diameter, i.e., set (2) or (3). Show child how to carry the unopened box in two hands.
2. Place the box on a felt mat on a table. Remove the lid and put it under the box. Take the cylinders out.
3. Arrange the cylinders in their proper sequence along a straight line.
4. Break the order of the sequence and invite the child to repeat the exercise.

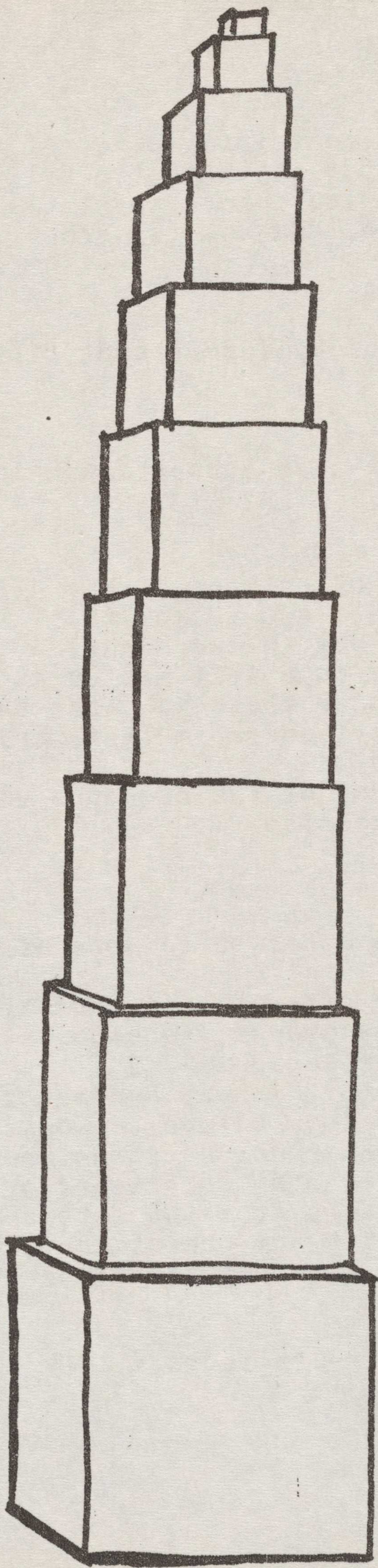
LATER EXERCISES

1. Introduce the other three sets of cylinders one at a time.
2. Place any two sets of cylinders alongside each other, preserving the proper sequence within each set, and make various comparisons.
3. The cylinders within any one set can be placed on top of another to form a tower. Construct those towers that form the more harmonious structures.
4. Introduce more than two sets of cylinders at one time, combine cylinders from two sets and compare the resultant combination with any one of the remaining sets of cylinders and make any other possible harmonious comparisons.

AGE Approximately 4-1/2 years.

CONTROL OF ERROR

Visual.



Pink Tower

PINK TOWER

MATERIAL

Ten pink-colored cubes, with sides of 1cm, 2cm, 3cm,.....
10 cm long.

DIRECT AIM

Visual discrimination of difference in dimension.

INDIRECT AIM

Education of voluntary movement. Preparation of the
Mathematical mind.

PRESENTATION

1. Child is shown how to carry the blocks, one at a time, to a mat on the floor. Each block is so placed that no one block touches another.
2. Teacher, standing, builds tower a little apart from the scattered blocks, centering each cube on the previous one, thus leaving an even margin around each base cube.
3. Teacher and child break the tower in an orderly fashion. The child is then invited to do the exercise by himself in the presence of the teacher.

LATER EXERCISES

1. Introduce language using the three period lesson: LARGE, SMALL; LARGER, LARGEST; SMALLER, SMALLEST. Build tower using language.
2. Build tower in form of a staircase such that two sides of the vertical structure will make smooth planes. Then show that the smallest cube fits exactly on each stair.

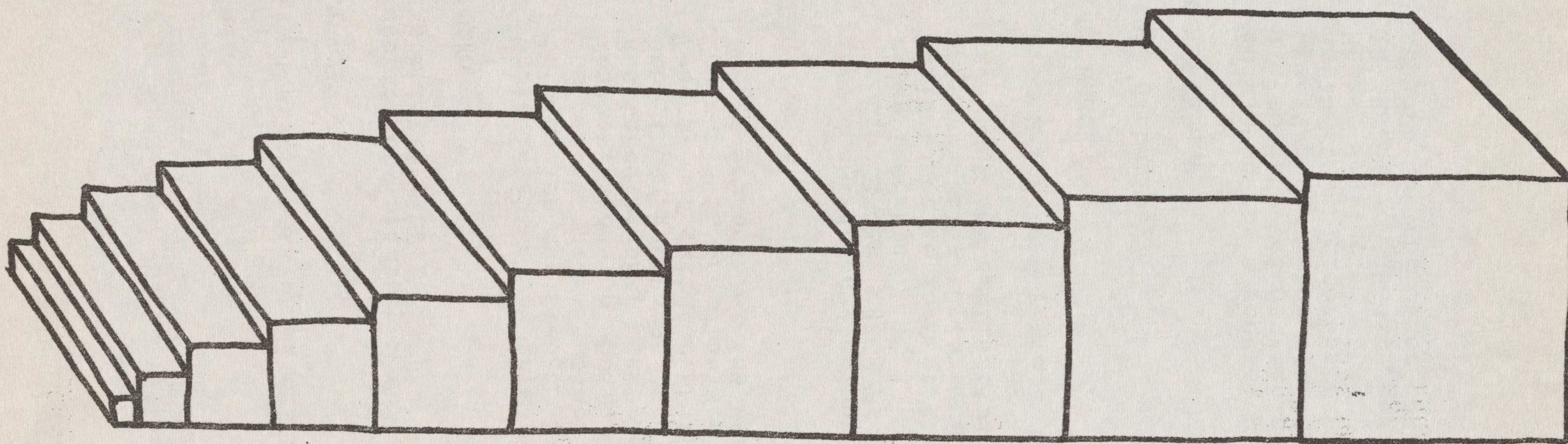
AGE From 2-1/2 to 3 years.

CONTROL OF ERROR

Visual disharmony.

POINTS OF INTEREST

1. Each cube has a special place in the progression to the top.
2. If the order of decreasing size of cubes is altered in the upward progression, the tower will become unstable.
3. As the tower progresses upward it becomes thinner. Cubes become smaller.
4. The heaviest cube is required to rest at the bottom as a support for the other cubes.



Brown Stair

BROWN STAIR

MATERIAL

Ten rectangular prisms, brown in colour, but differing in cross-sectional area. Each prism is 20cm. long. The cross-sectional area increases in length by one unit such that the following relationships exist between the volumes of the successive prisms:

4 of the first equals the second,
9 of the first equals the third,
16 of the first equals the fourth, etc.

DIRECT AIM

Visual discrimination of dimensions in thickness.

INDIRECT AIM

Muscular education of grip. Preparation for the mathematical mind.

PRESENTATION

1. Child is shown how to carry the blocks, one at a time, and place each block on a mat on the floor. No one prism may touch another.
2. Teacher selects the thinnest prism, lifting it with the fingers of one hand stretched across its width, and places it apart from the other scattered blocks. She SEARCHES for the prism of the next order of thickness and places it alongside the length of the previous block. This is continued until the supply of the blocks is exhausted. The completed structure will suggest a staircase.
3. The staircase is broken in an orderly fashion and the child is invited to do the exercise by himself.

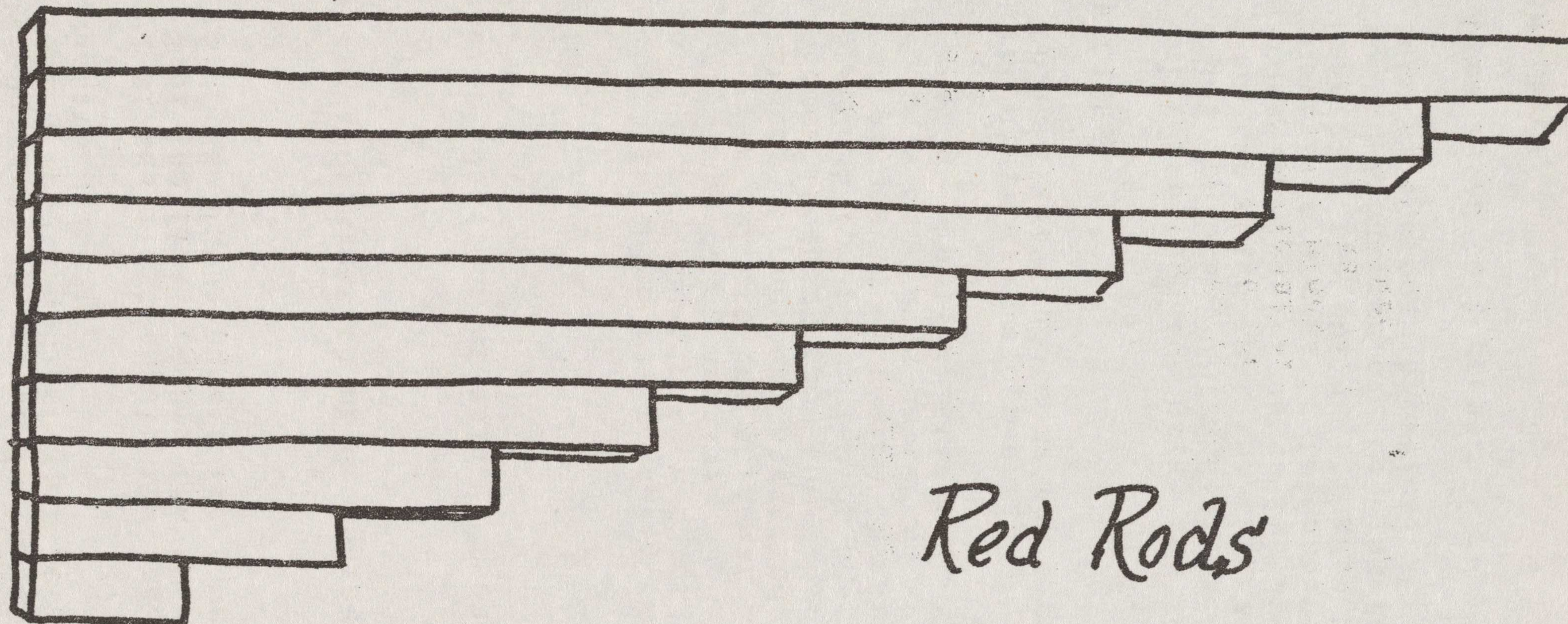
LATER EXERCISES

1. Introduce language using the three period lesson: THICK, THIN; THICKER, THINNER; THICKEST, THINNEST.
2. Show the child that the thinnest block is of the same cross-sectional area as the step that separates any two successive blocks in the staircase.
3. Hopefully the child will have DISCOVERED relationships to the structure of the Pink Tower. If not, show him some of the possibilities.

AGE From 2-1/2 to 3 years.

CONTROL OF ERROR

Visual disharmony.



Red Rods

RED RODS

MATERIAL

Ten rods, red in colour, that differ only in length. The shortest rod is 10cm. long, with each succeeding rod differing from the preceeding one by this length.

DIRECT AIM

Visual discrimination of length dimension.

INDIRECT AIM

Preparation for number work.

PRESENTATION

1. The child is shown how to carry the rods, one at a time, with one hand on each end of the rod. Each rod is placed on a mat on the floor so that no rod touches another.
2. The teacher selects the shortest rod and places it apart from the others. She searches for the next longest rod in the series and places it away from her and alongside the first rod selected. She continues placing the rods in this fashion until the supply is exhausted. The left ends of the rods form a smooth rectangular plane. As each rod is placed into position, the teacher strokes its entire length.
3. The teacher breaks the stair-like structure, scatters the rods, and invites the child to build a like structure by himself.

LATER EXERCISES

1. Introduce language using the three period lesson: LONG, SHORT; LONGER, SHORTER; LONGEST, SHORTEST.
2. Show that the shortest rod is the unit of measure for the difference in length between the succeeding pieces that form the series.

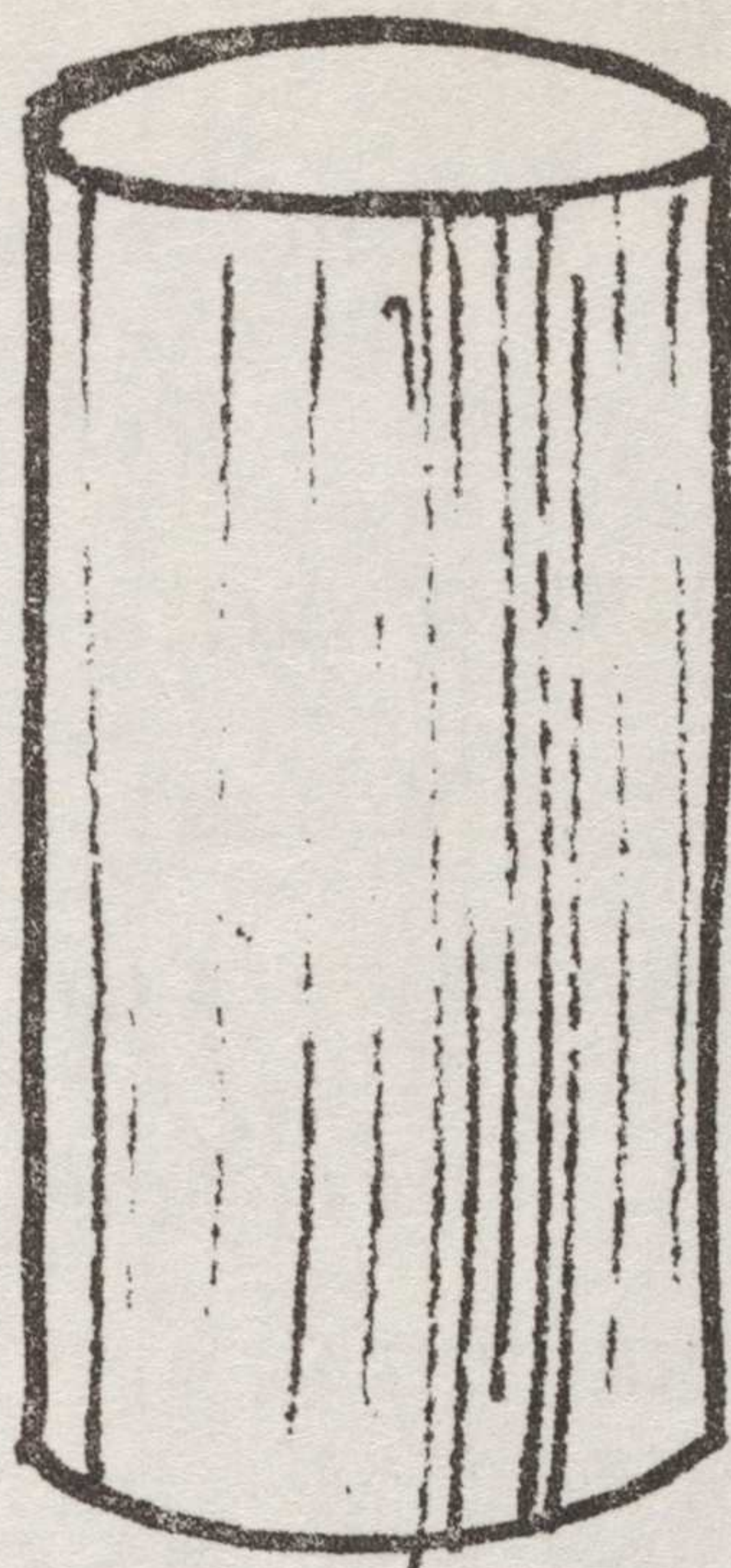
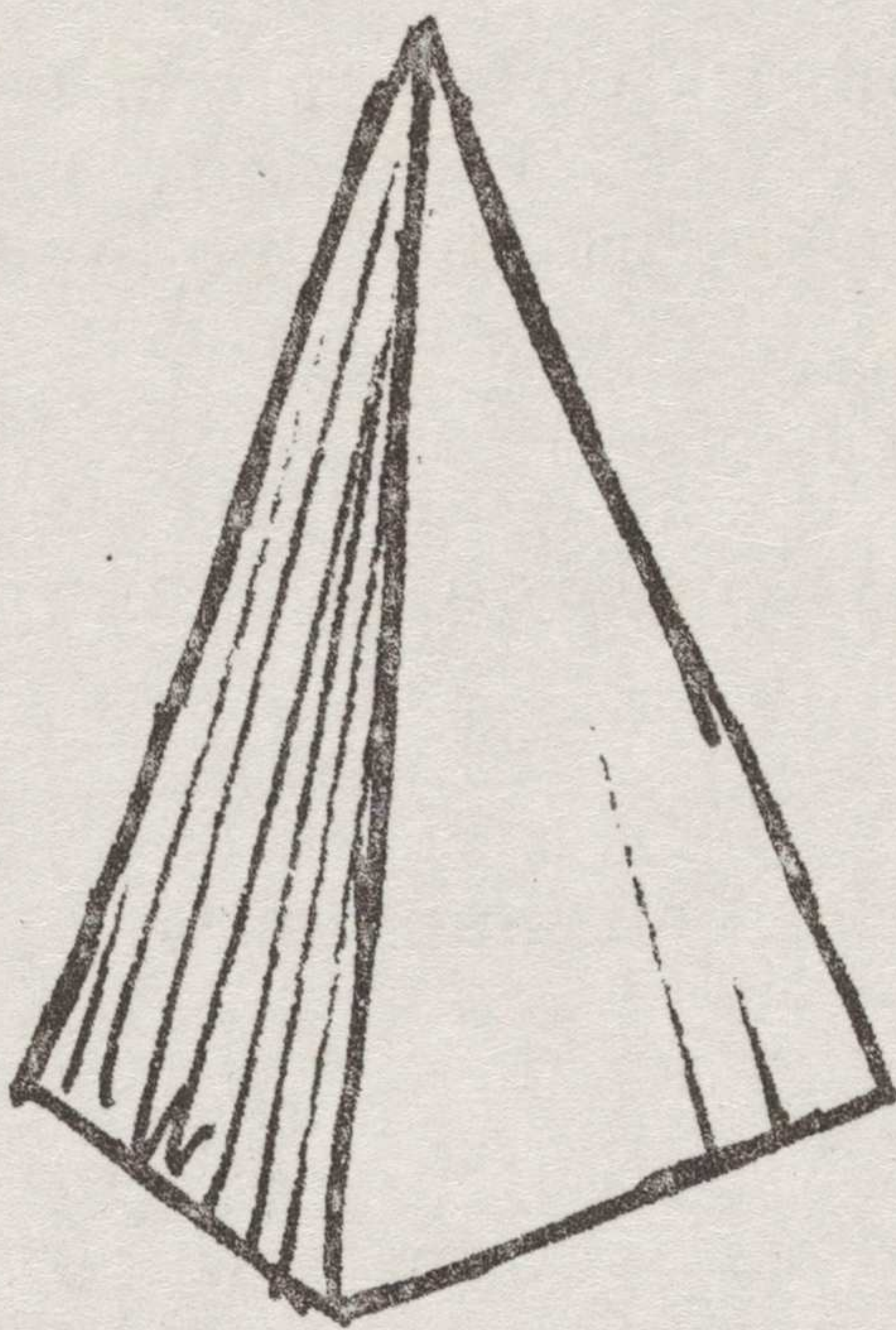
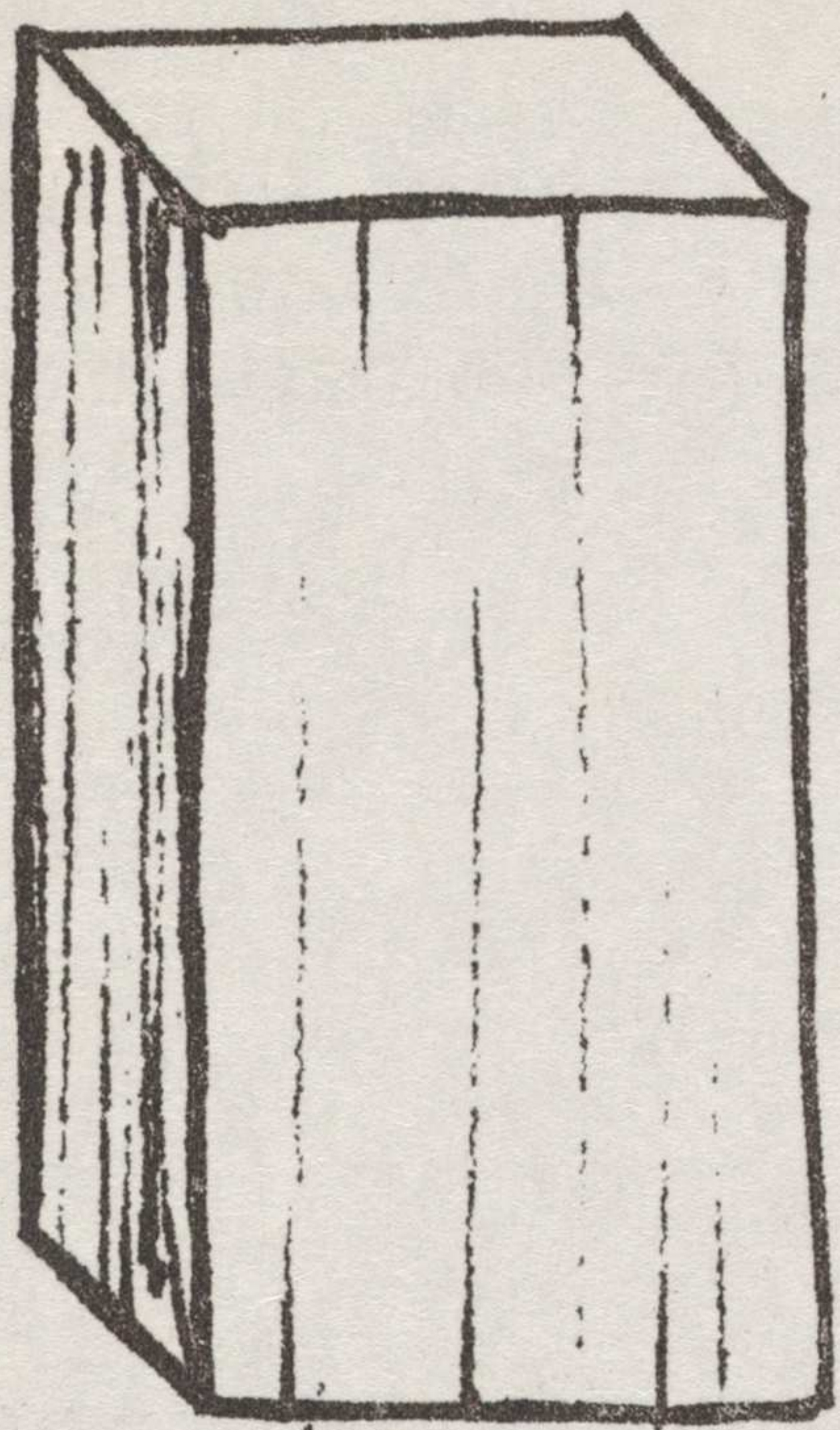
AGE From 2-1/2 to 3 years.

CONTROL OF ERROR

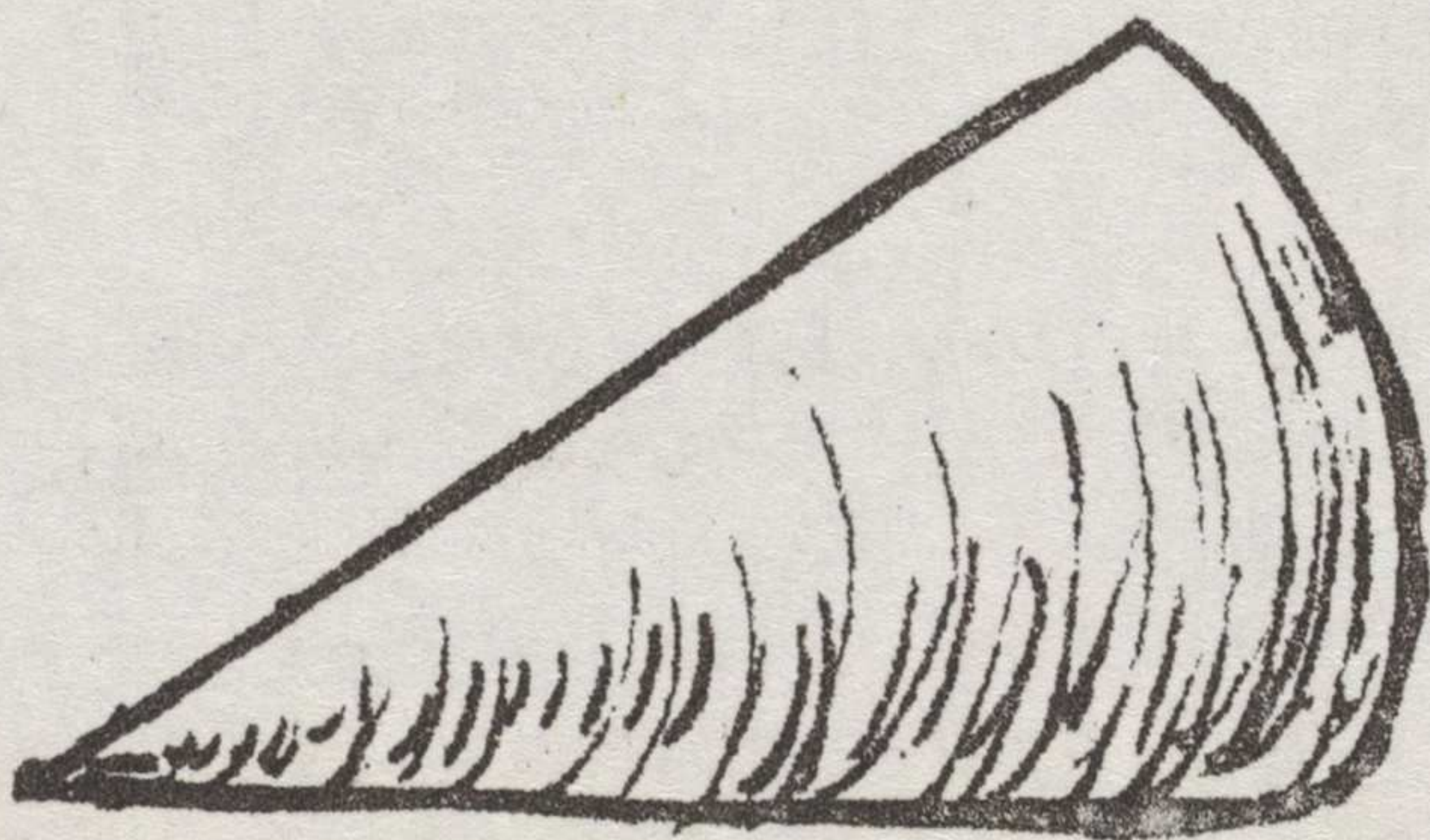
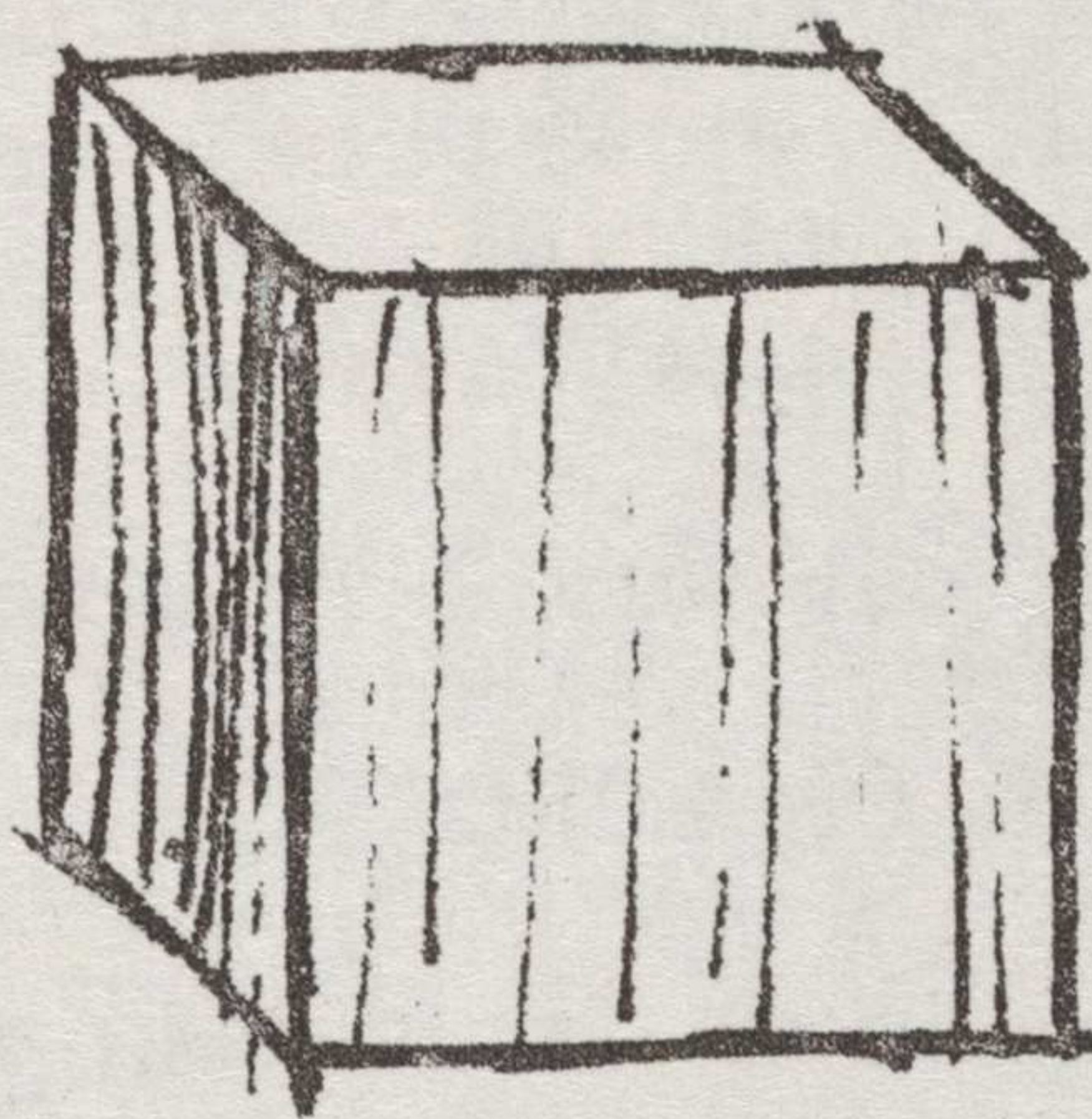
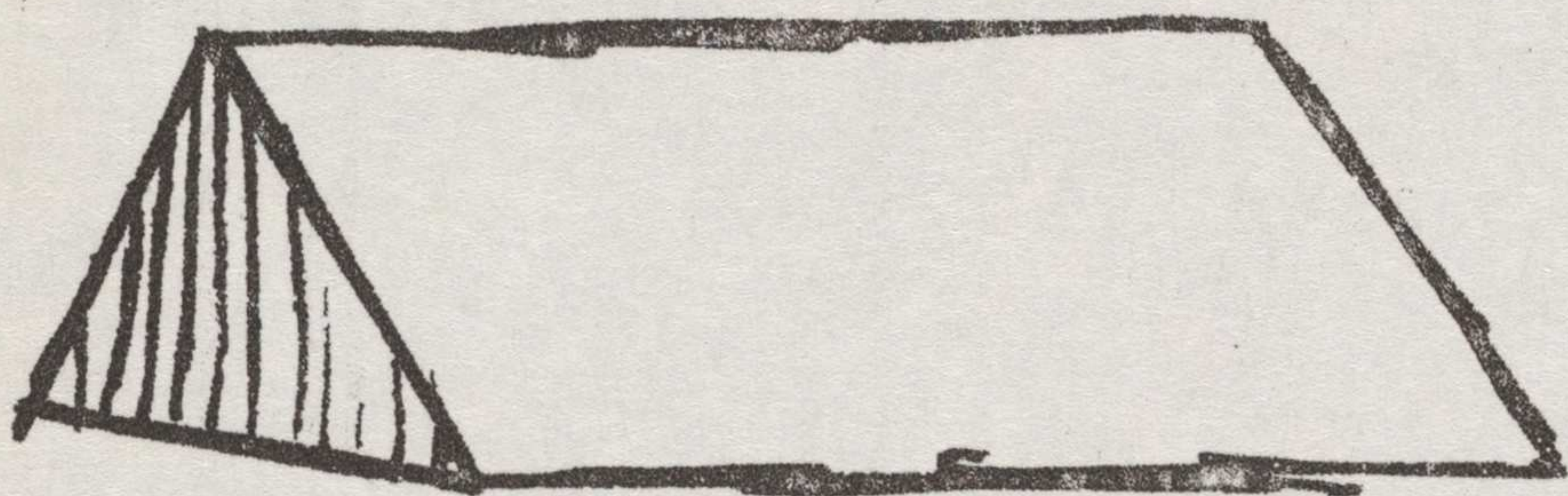
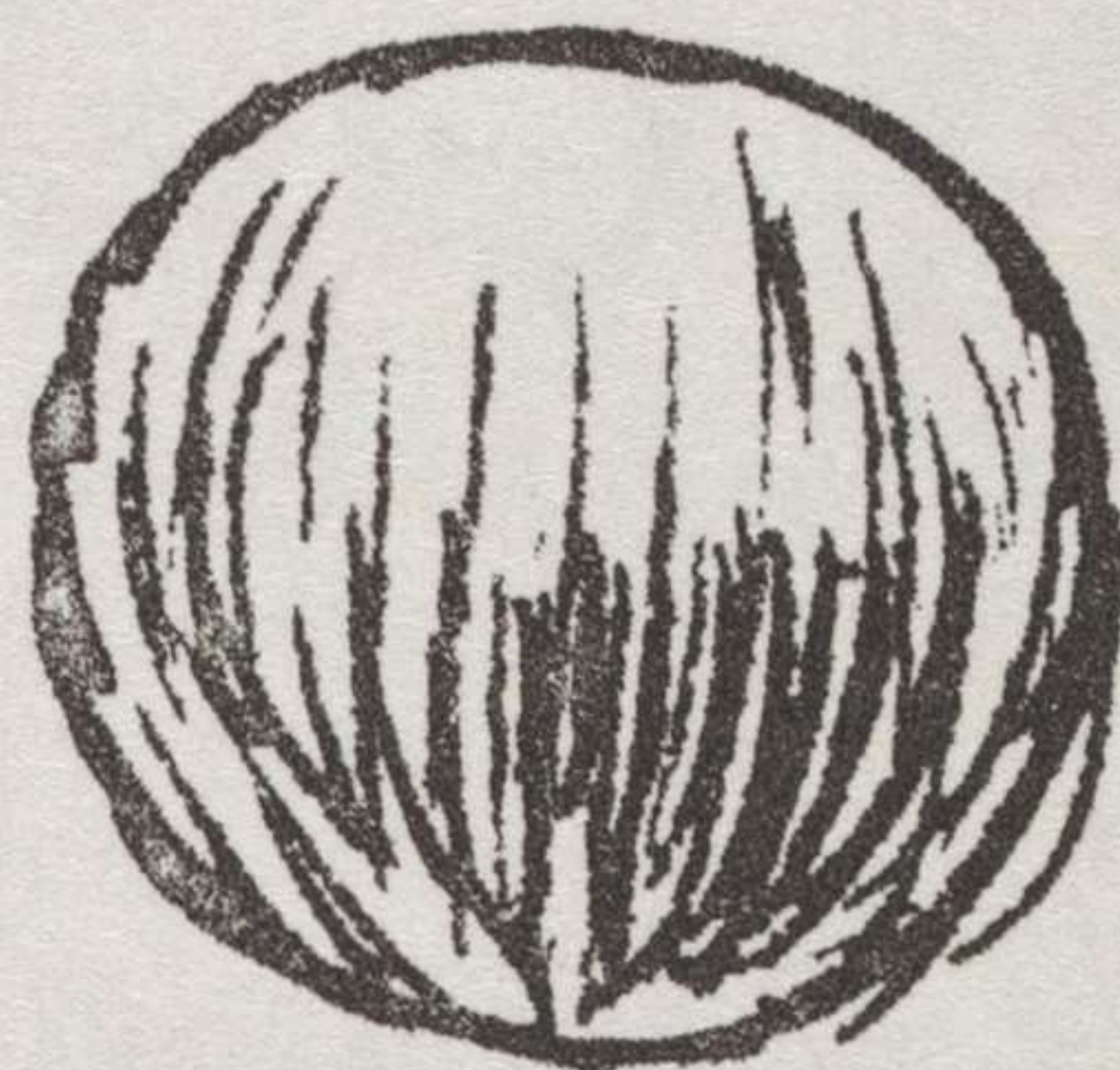
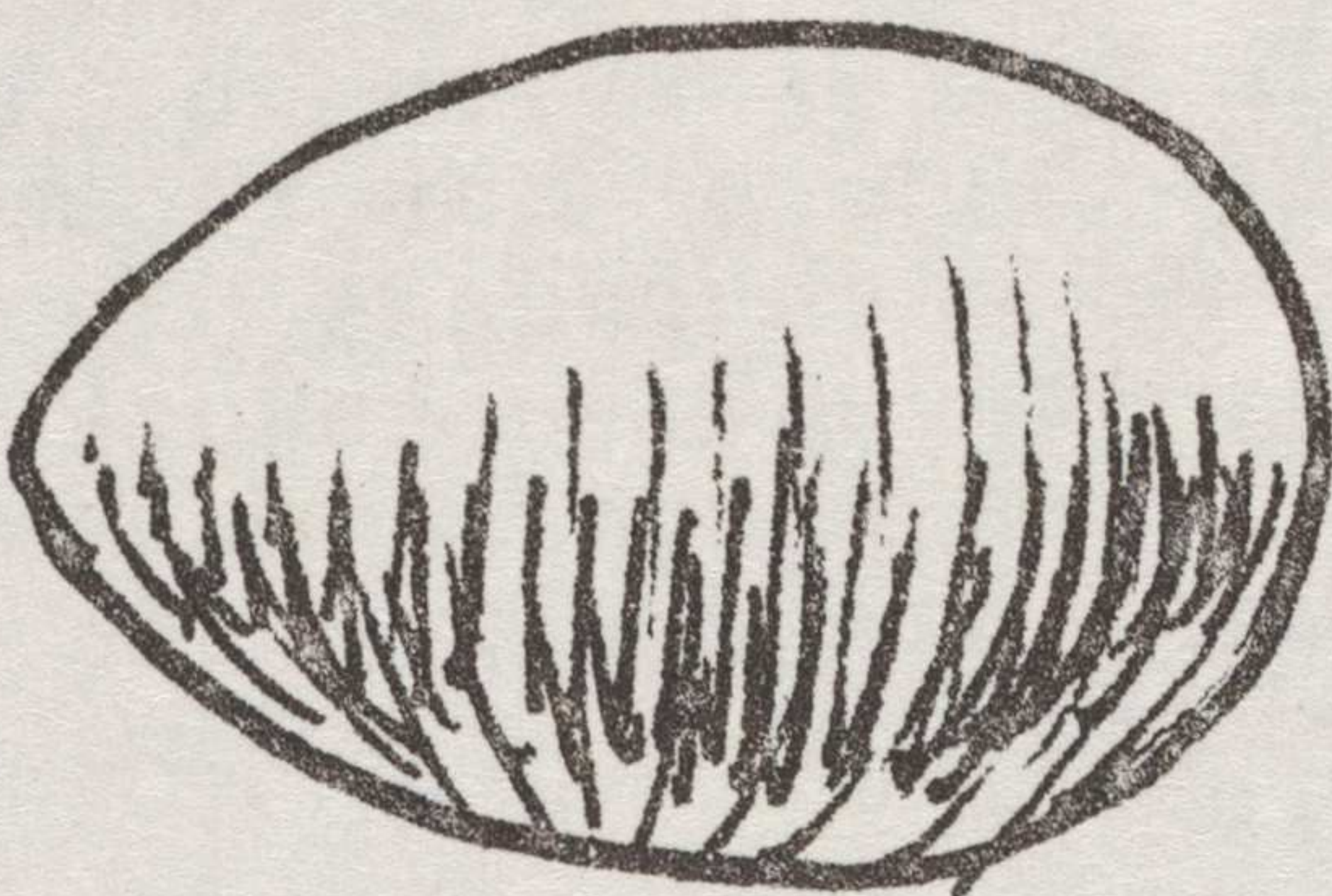
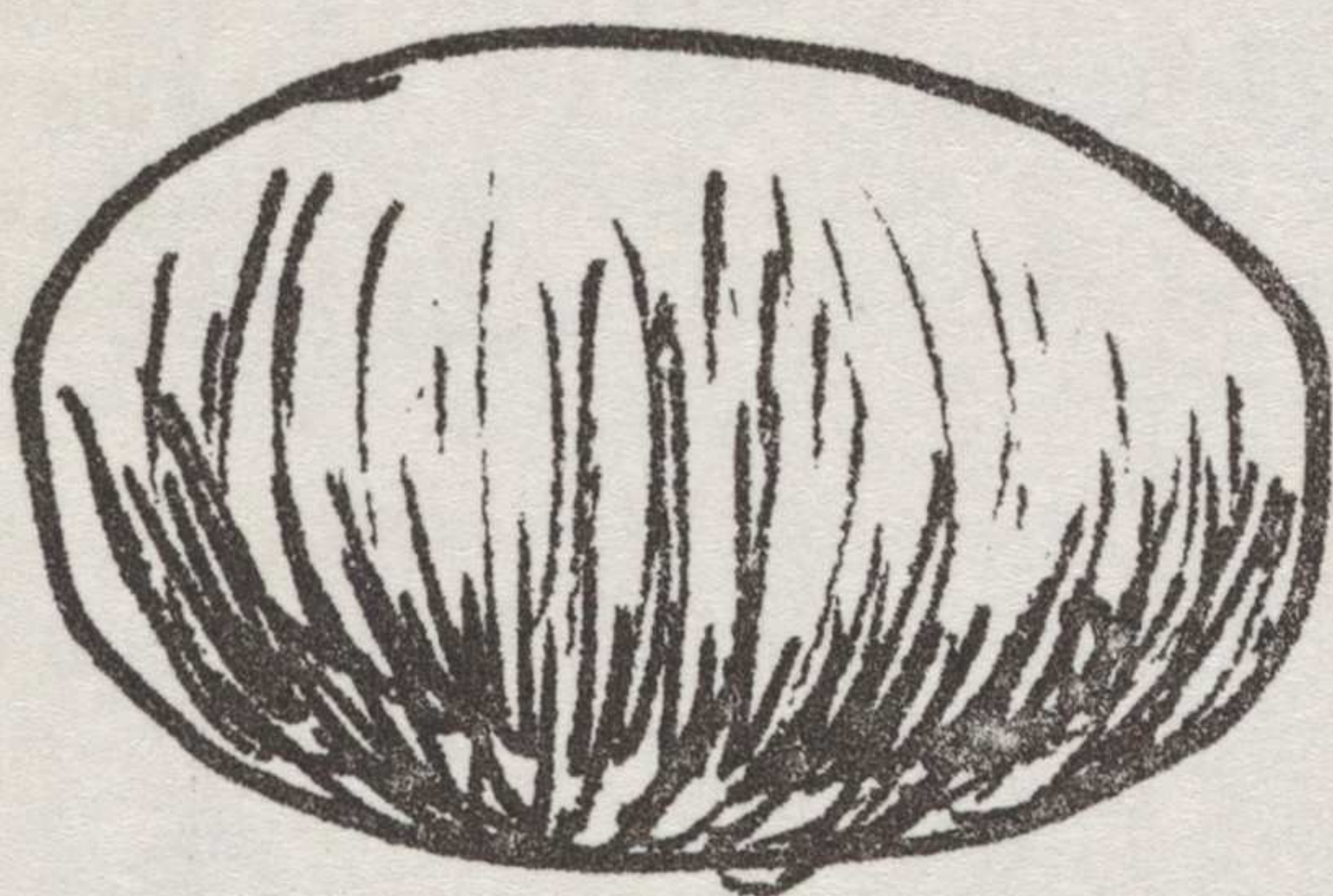
Visual disharmony.

POINTS OF INTEREST

1. As each successive rod is put in place, we see a stair-like structure at one end and a smooth plane at the other end.
2. We note that the shortest rod is the unit of measure for all the other rods. This measurement follows an ordered progression.



Geometric Solids



GEOMETRIC SOLIDS

MATERIAL

Dark blue, geometric solids: sphere, ovoid, ellipsoid, cube, rectangular prism, cone, triangular prism, and square pyramid. A number of wooden tablets each of which will serve as a base for one or more solid that has at least one flat surface.

Two baskets and one attractive cloth that will cover a basket.

DIRECT AIM

To make the child aware of the solid geometric forms that surround him in his environment.

INDIRECT AIM

Preparation for geometry.

PRESENTATION

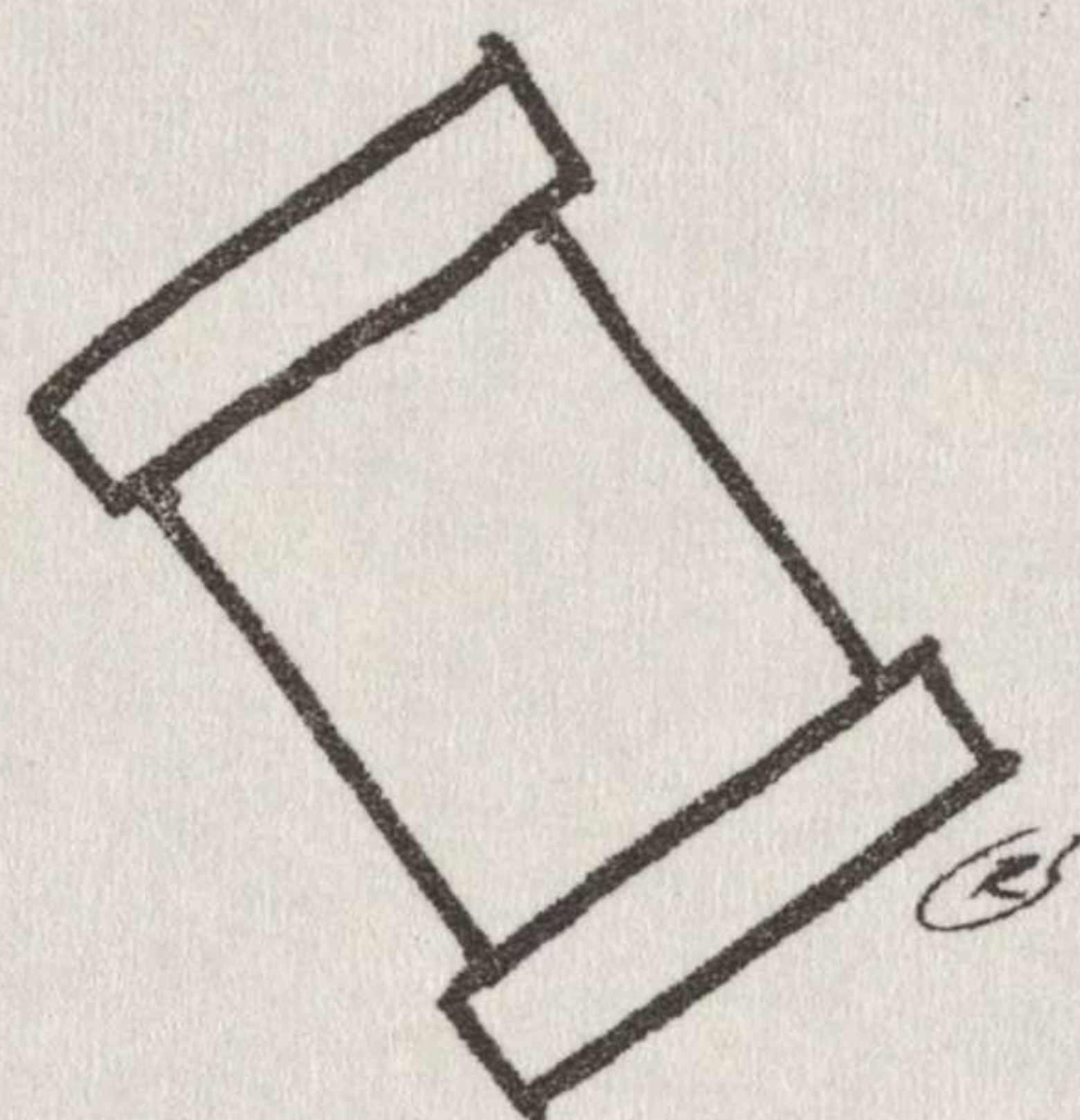
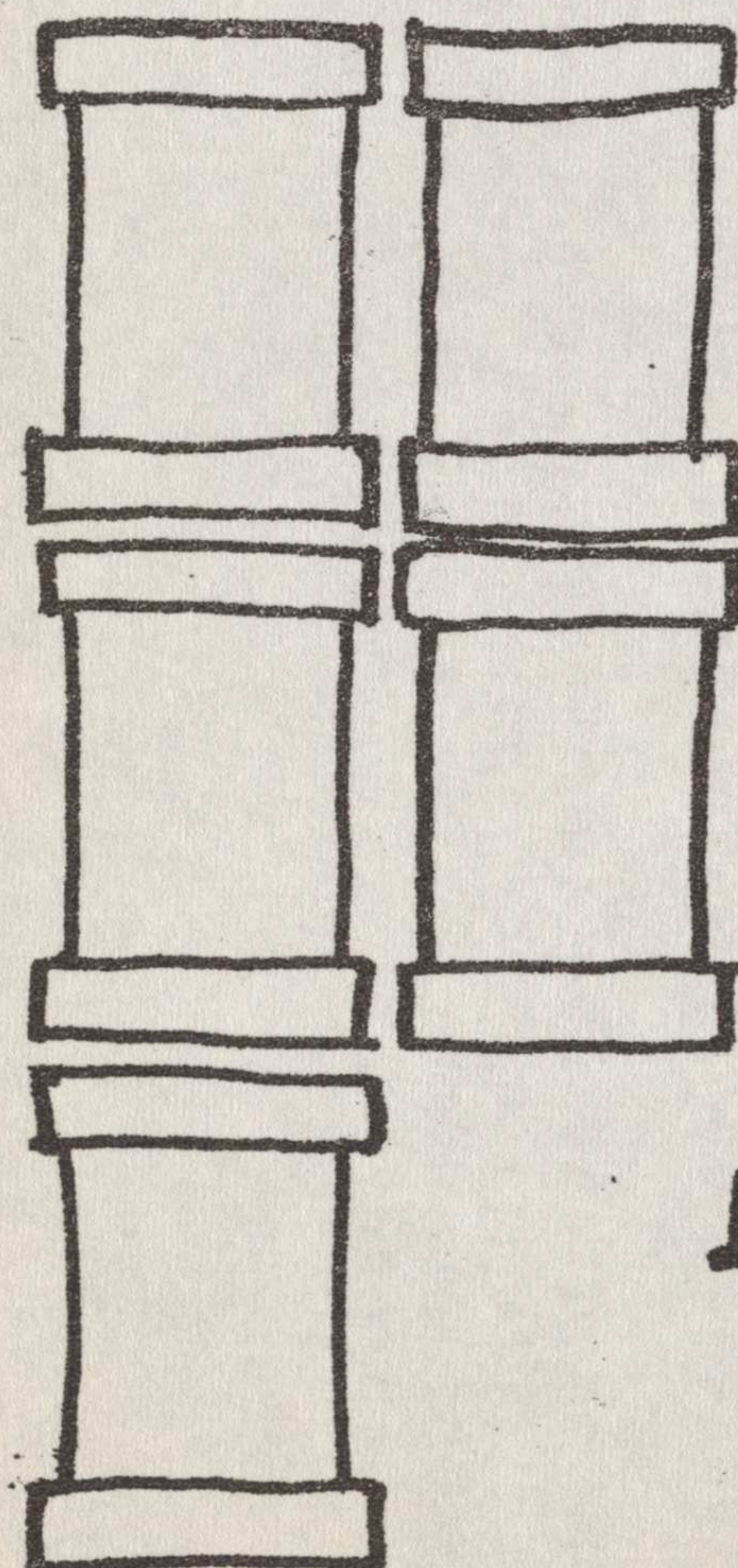
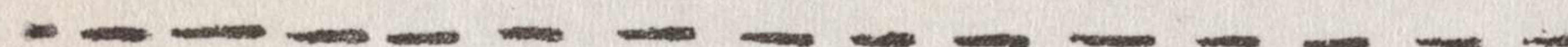
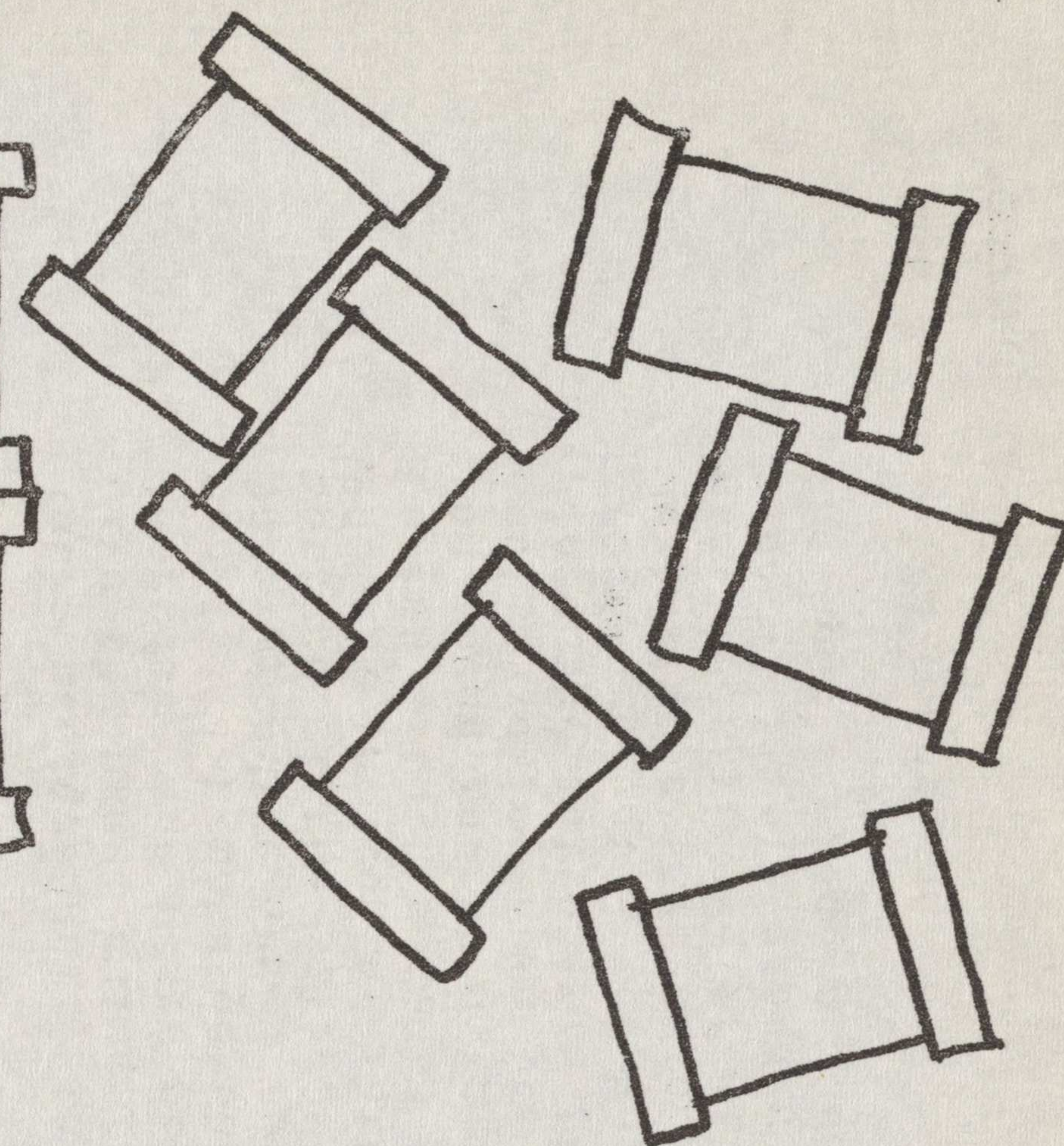
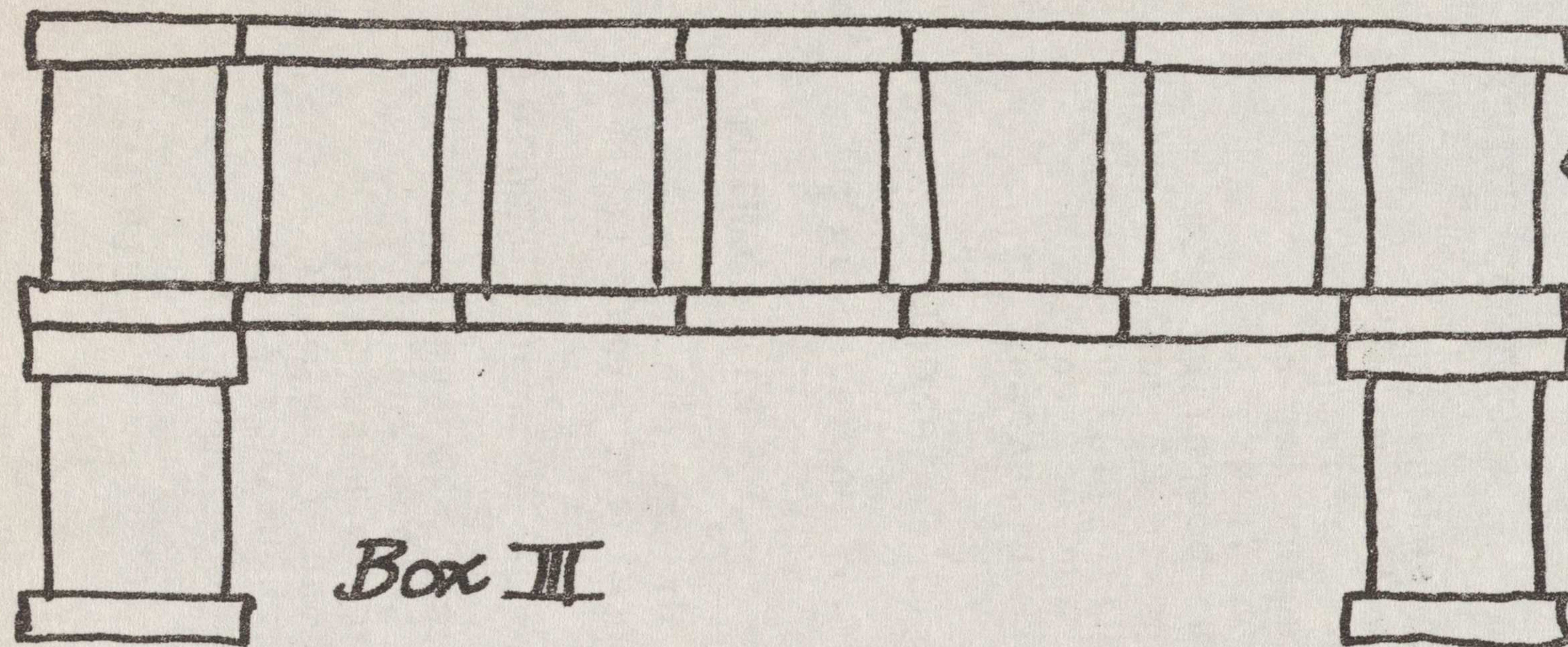
1. Remove the solids, one at a time, from one of the baskets feeling the surfaces, edges and points. Permit the child to obtain the same sensory perception of the forms that are involved.
2. Introduce three of the solids the shape of which the child is likely to have had more frequent contact in his day-to-day surroundings than with the other shapes; e.g., the sphere is like a ball, the ovoid is similar in shape to an egg, etc. Use the three period lesson in explaining the shapes of the solids that you introduced.

LATER EXERCISES

1. Introduce gradually the solids not used heretofore and give the names using the three period lesson.
2. Introduce the bases placing each solid that has at least one flat surface on the appropriate base, i.e., on the base with the same cross-sectional shape as the flat surface of the solid.
3. Put all the solids into one of the baskets and cover the basket with the cloth provided for this purpose. With your hand inserted in the basket and covered by the cloth, feel a solid, name it, and then expose it to view. Then place the solid into the empty basket. Continue this procedure until the basket is empty.
4. Demonstrate the various ways in which some of the solids will freely move if given a slight impetus, e.g., the cone will roll along a circular path as will the ovoid, the sphere along a straight line, etc.

AGE 2-1/2 years and up.

CONTROL OF ERROR - The teacher supplies the control.



Color Tablets

COLOR TABLETS**MATERIAL**

One box containing three pairs of tablets of the basic colors of red, blue, and yellow. The other box containing eleven pairs of tablets colored in an intense red, orange, yellow, green, blue, violet, pink, grey, brown, black, and white.

A third box subdivided into nine compartments, with each compartment containing 7 tablets. The nine sets of 7 tablets each are colored in shades of varying intensity of the following colors: grey (from black to white), red, orange, yellow, green, blue, violet, brown, maroon. The tablets are of light-wood construction, are covered with colored silk or are painted.

DIRECT AIM - Development of chromatic sense.

INDIRECT AIM - Preparation for art work.

PRESENTATION

1. Select the first box. Show the child how to hold a tablet by its two wooden rims.
2. Remove the tablets from the box mixing them on a mat on the table in front of the child.
3. Arrange the tablets in pairs of the same color by placing them such that one pair is separated from the other by the wooden rims that are attached to each tablet.
4. Mix the tablets and invite the child to repeat the exercise by himself.

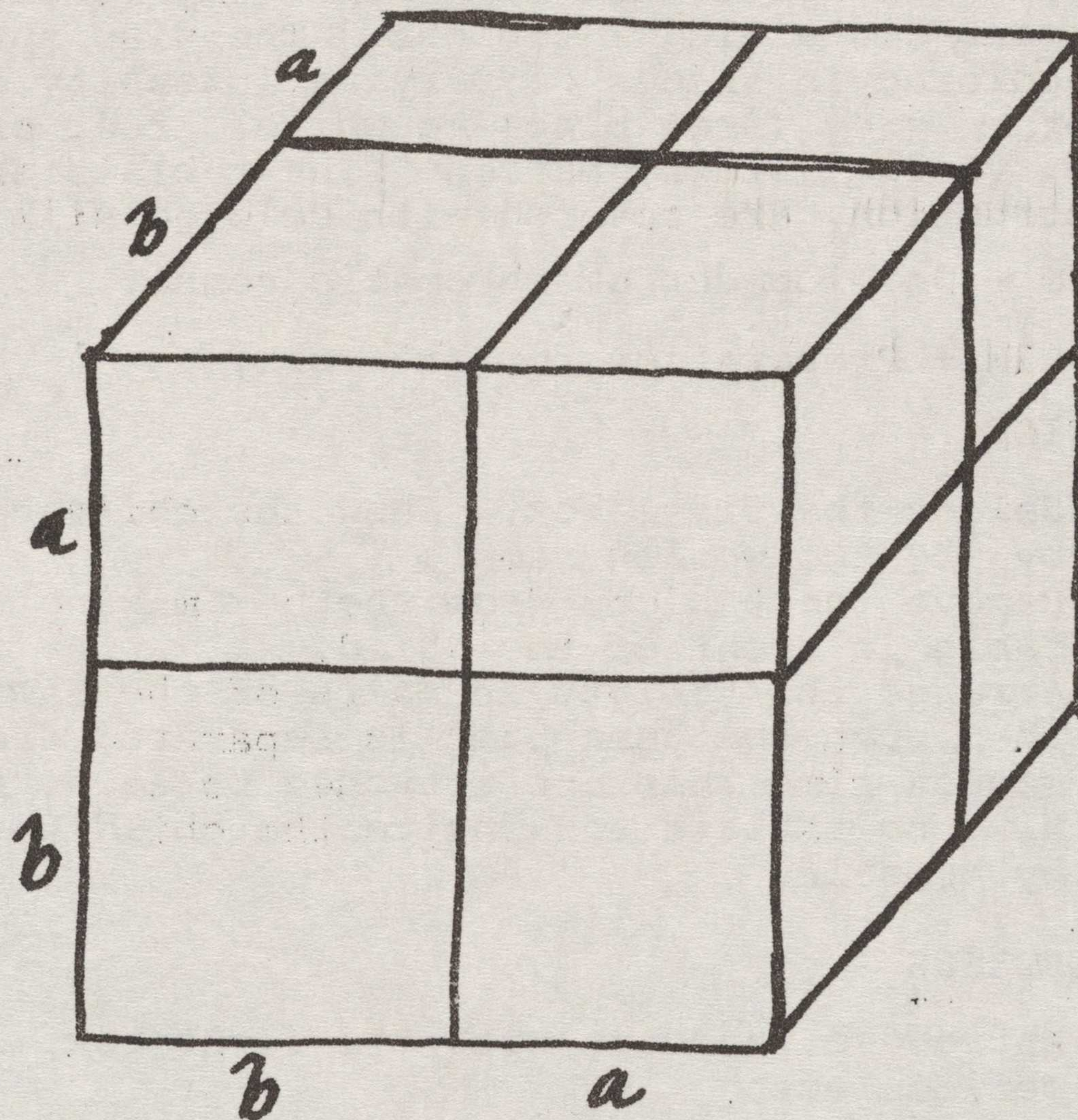
LATER EXERCISES

1. Introduce language with the first box, using the three period lesson.
2. Introduce the second box, using three new colors; REVIEW the matching exercise with the six colors; repeat this procedure until the supply of tablets is exhausted.
3. Introduce language with the second box in the same gradual manner as was suggested in the previous exercise.
4. a) Introduce the third box. This is done most easily as a floor exercise. Select one color, placing the tablet of the lightest tint at a distance from the tablet of the darkest shade. Fill in this distance with the other tablets by arranging these in order of color intensity.
 b) Arrange in order of color intensity the tablets of two contrasting colors.
 c) Arrange in order of color intensity the tablets of two colors that are adjacent on the color wheel.
 d) Arrange in order of color intensity the tablets of all nine colors.
5. Introduce language with the third box; DARK, LIGHT, etc., with comparatives and superlatives.

AGE From 2-1/2 to 5 years.

CONTROL OF ERROR - Visual

Note: Tint - the color with white added
 Shade - the color with black added



Binomial Cube

BINOMIAL CUBE**MATERIAL**

A square box that contains eight wooden rectangular prisms and cubes. When assembled, the prisms and cubes form a large cube, with each of its components representing - in three-dimensional space - a term in the $(a+b)^3$ expansion. Thus there is a red cube with the dimension a^3 , a blue cube b^3 , three blue and black rectangular prisms to represent the term b^2a and three red and black rectangular prisms each with dimension a^2b . The $(a+b)^2$ expansion is painted on the lid of the box.

DIRECT AIM

To build the cube.

INDIRECT AIM

Preparation for Algebra.

PRESENTATION

1. Place the box on a mat on a table.
2. Remove the lid from the box and pull down two of the adjacent sides. Place the lid, with the pattern showing, in the rectangular space formed on the table by the two sides.
3. Remove the building blocks from the box and place them on the mat.
4. Order the blocks into groups of like dimensions.
5. Build the cube in the box by completing the lower before starting the second level. First place the red cube in the position as indicated on the pattern. Then by matching like surfaces construct the cube.

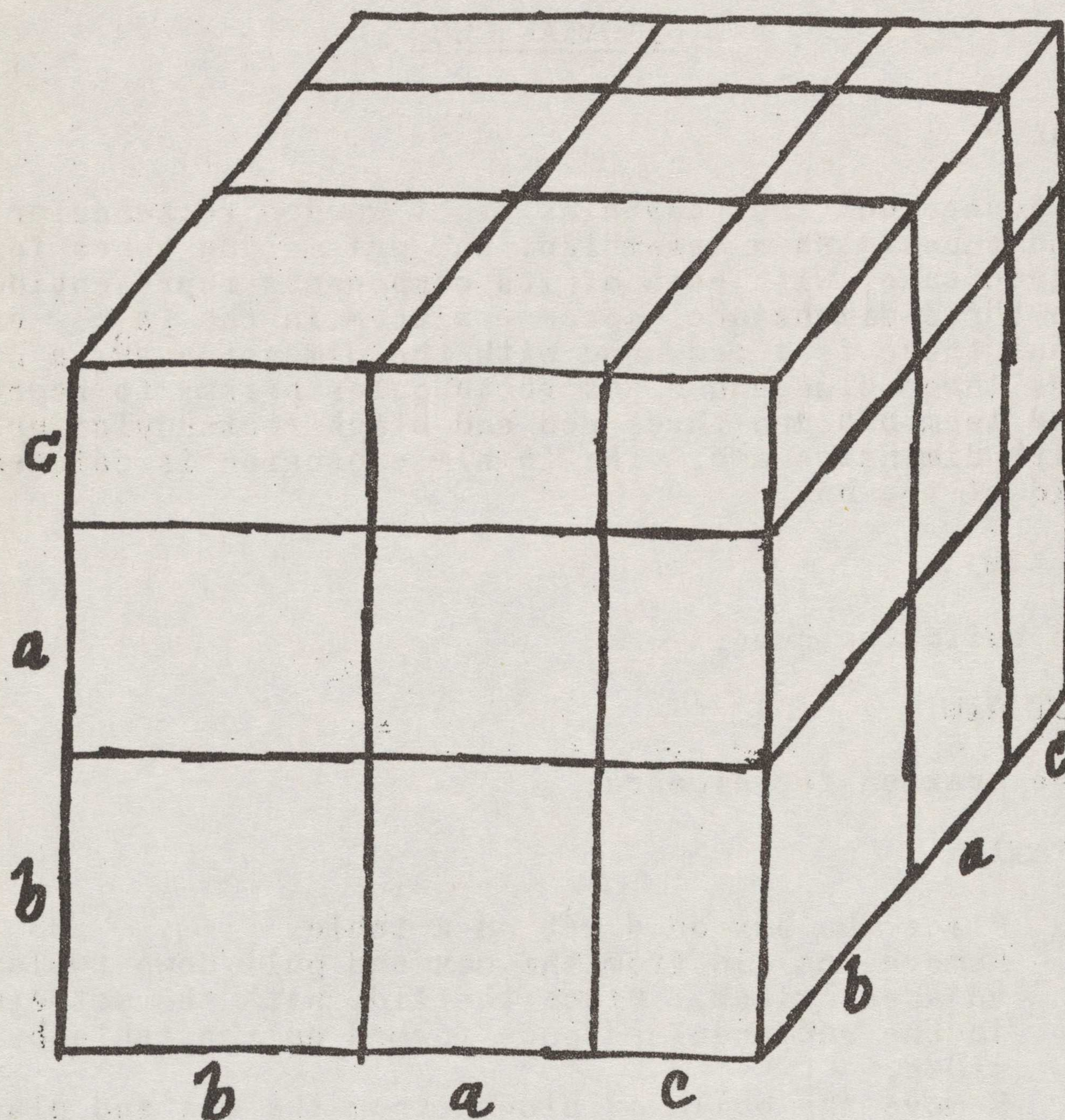
LATER EXERCISES

1. Build the cube apart from the box, completing the first level before starting on the second. As a point of interest, slice the cube first vertically and then horizontally comparing the formed surfaces with the pattern on the lid.
2. Build the cube by first assembling the two levels separately and then superimposing one level on top of the other.

AGE 3 to 5 years.

CONTROL OF ERROR

Visual.



Trinomial Cube

TRINOMIAL CUBEMATERIAL

A square box that contains 27 wooden, rectangular prisms and cubes. When assembled, the prisms and cubes form a large cube, with each of its components representing - in three-dimensional space - a term in the $(a+b+c)^3$ expansion. The numbers, representative terms, and colors of the building blocks are as follows:

<u>number</u>	<u>term</u>	<u>color</u>
1	a^3	red
1	b^3	blue
1	c^3	yellow
3	b^2a	blue and black
3	a^2b	red and black
3	a^2c	red and black
3	b^2c	blue and black
3	c^2a	yellow and black
3	c^2b	yellow and black
6	abc	black

The $(a+b+c)^2$ expansion is represented in a pattern that is painted on the lid of the box.

DIRECT AIM - To build the cube.

INDIRECT AIM - Preparation for Algebra.

PRESENTATION

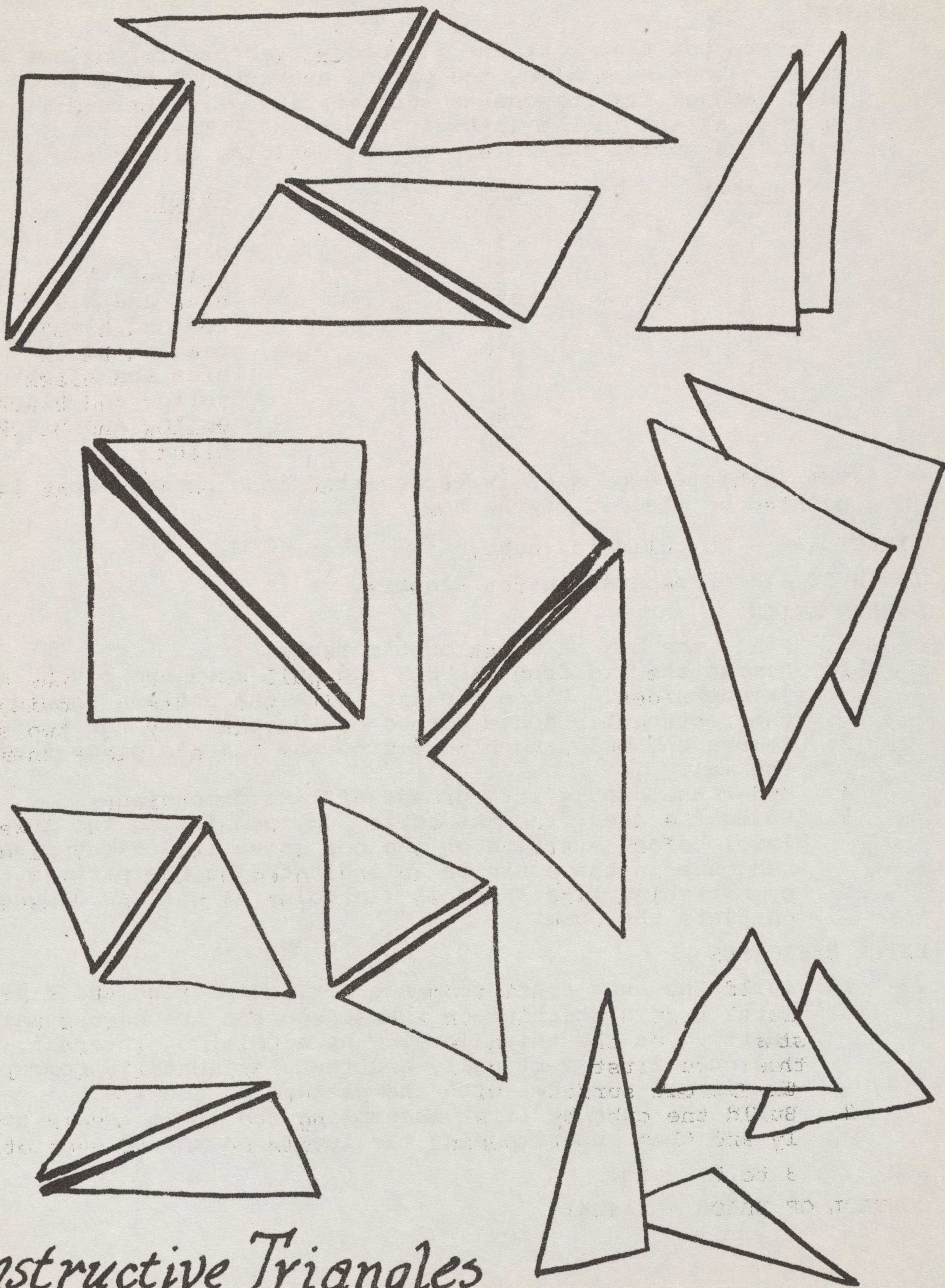
1. Place the box on a mat on the table.
2. Remove the lid from the box and pull down two of the adjacent sides. Place the lid, with the pattern showing, in the rectangular space formed on the table by the two sides.
3. Remove the building blocks from the box and place them on the mat.
4. Order the blocks into groups of like dimensions.
5. Build the cube from the bottom up, completing the lower level before starting on the one above it. First place the red cube in the position as indicated on the pattern. Then by matching like surfaces (in color as well as dimension) complete the cube.

LATER EXERCISES

1. Build the cube apart from the box, completing the first level before starting on the second and the second before starting on the third level. As a point of interest, slice the cube first vertically and then horizontally comparing the formed surfaces with the pattern on the lid.
2. Build the cube by first assembling the three levels separately and then superimposing the levels on top of each other.

AGE 3 to 5 years.

CONTROL OF ERROR - Visual



Constructive Triangles
Box I

CONSTRUCTIVE TRIANGLES - RECTANGULAR BOX

MATERIAL

A rectangular wooden box that contains fourteen wooden triangles. A set of our triangles - all of which are painted green - consists of two right-angled isosceles triangles and two right-angled scalene triangles. One scalene and another right-angled scalene triangle are painted red. Two right-angled scalene triangles are painted grey. A set of six yellow triangles that contains two equilateral triangles, two right-angled scalene, and two right-angled isosceles triangles. One side of each of the triangles is outlined by a heavy black border.

A second rectangular wooden box that contains eight triangles all of which are painted blue. Two of these are right-angled isosceles triangles, two are equilateral, three right-angled scalene, and one is a scalene triangle.

DIRECT AIM

To make the child aware that many plane figures are combinations of different types of triangles.

INDIRECT AIM

Preparation for geometry.

PRESENTATION

1. Place the first box of triangles on a rug on the floor.
2. Remove the triangles from the box and mix them. Then pair them according to shape and color placing the black-bordered sides tangential to each other. The resultant geometrical forms will comprise the rhombus, rhomboid, rectangle, square, and trapezoid.
3. Mix the triangles again and invite the child to do the matching for himself.

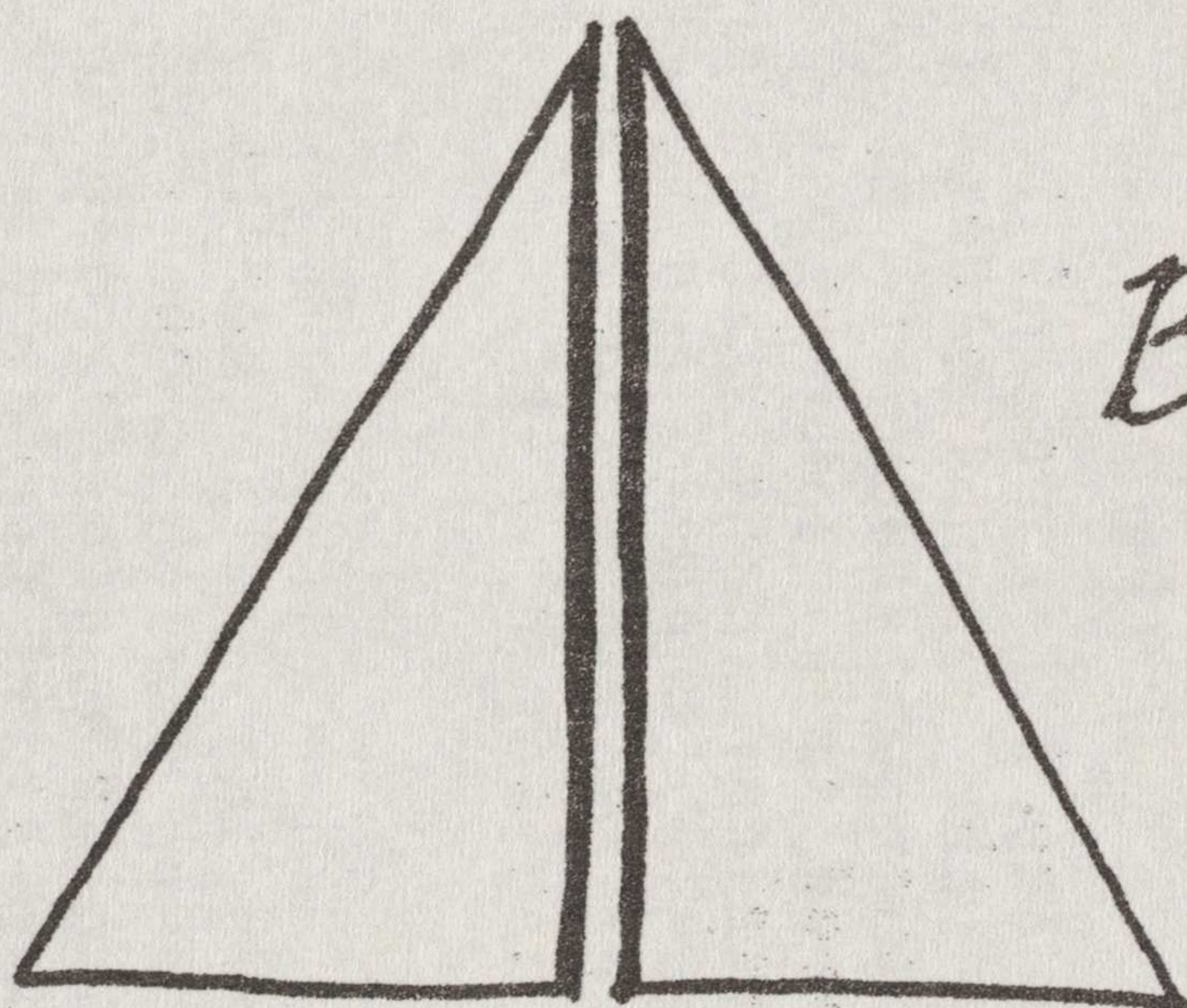
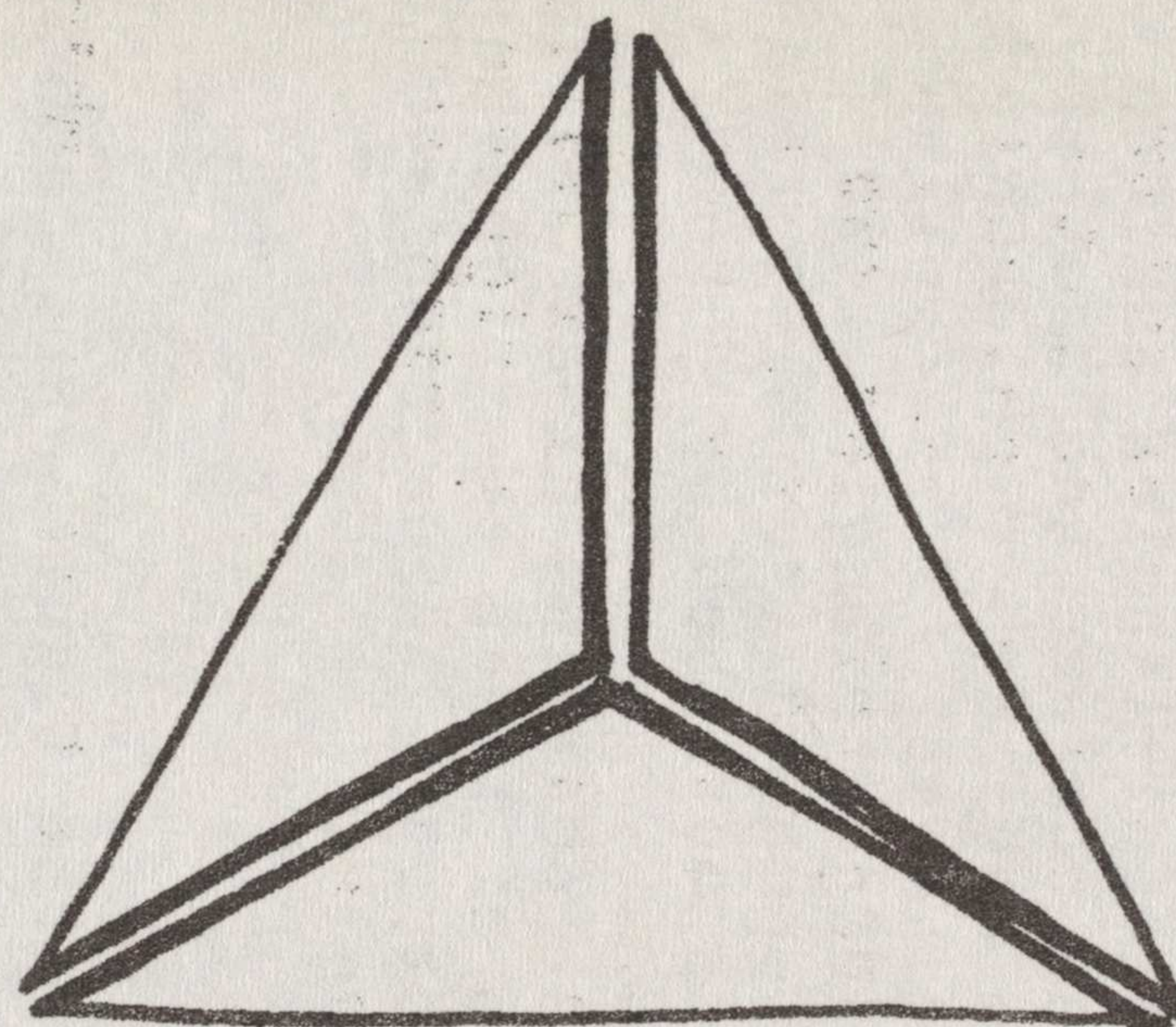
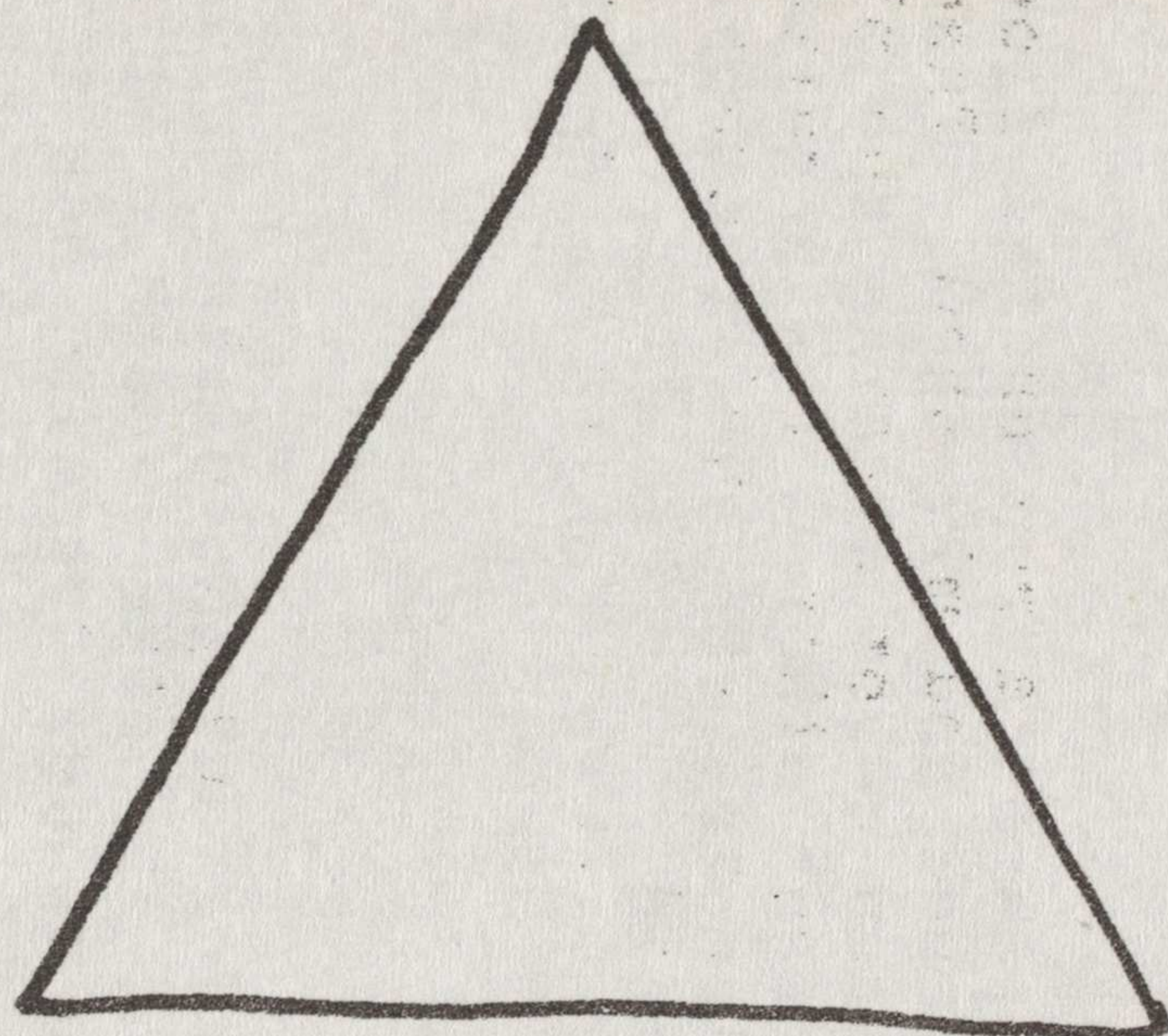
LATER EXERCISES

1. Introducing the second box, pick any two of the triangles that have at least one side of the same length. Slide the two triangles around each other, creating new three or four-sided forms.
2. Point out similarities between the forms you have created and forms found in the environment.
3. While these are the basic exercises, they are by no means the only ones. The child can make many spontaneous applications such as drawing the figures that he has constructed, or cutting out the triangles in colored paper and glueing them together, etc.

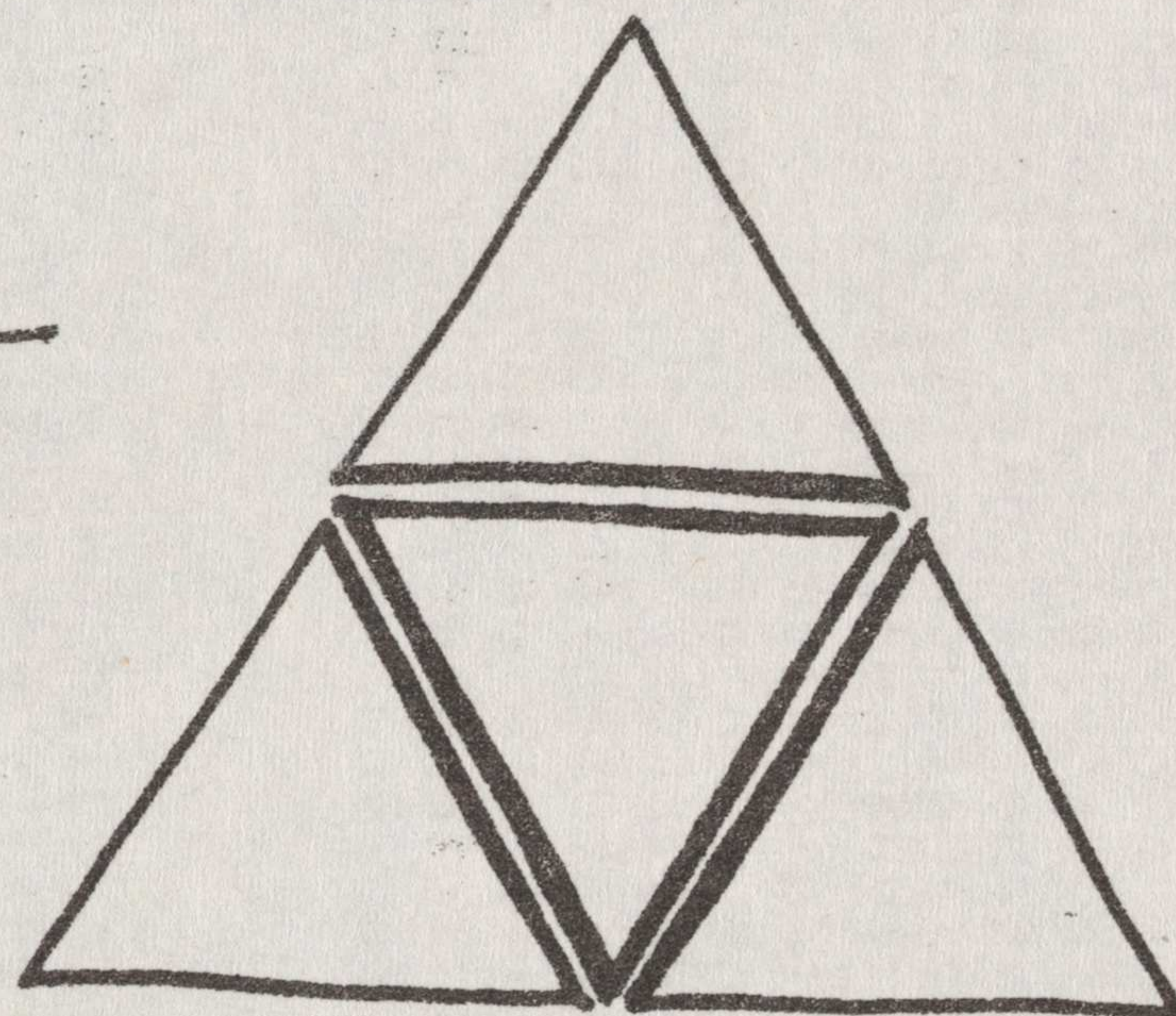
AGE 3 to 4 years.

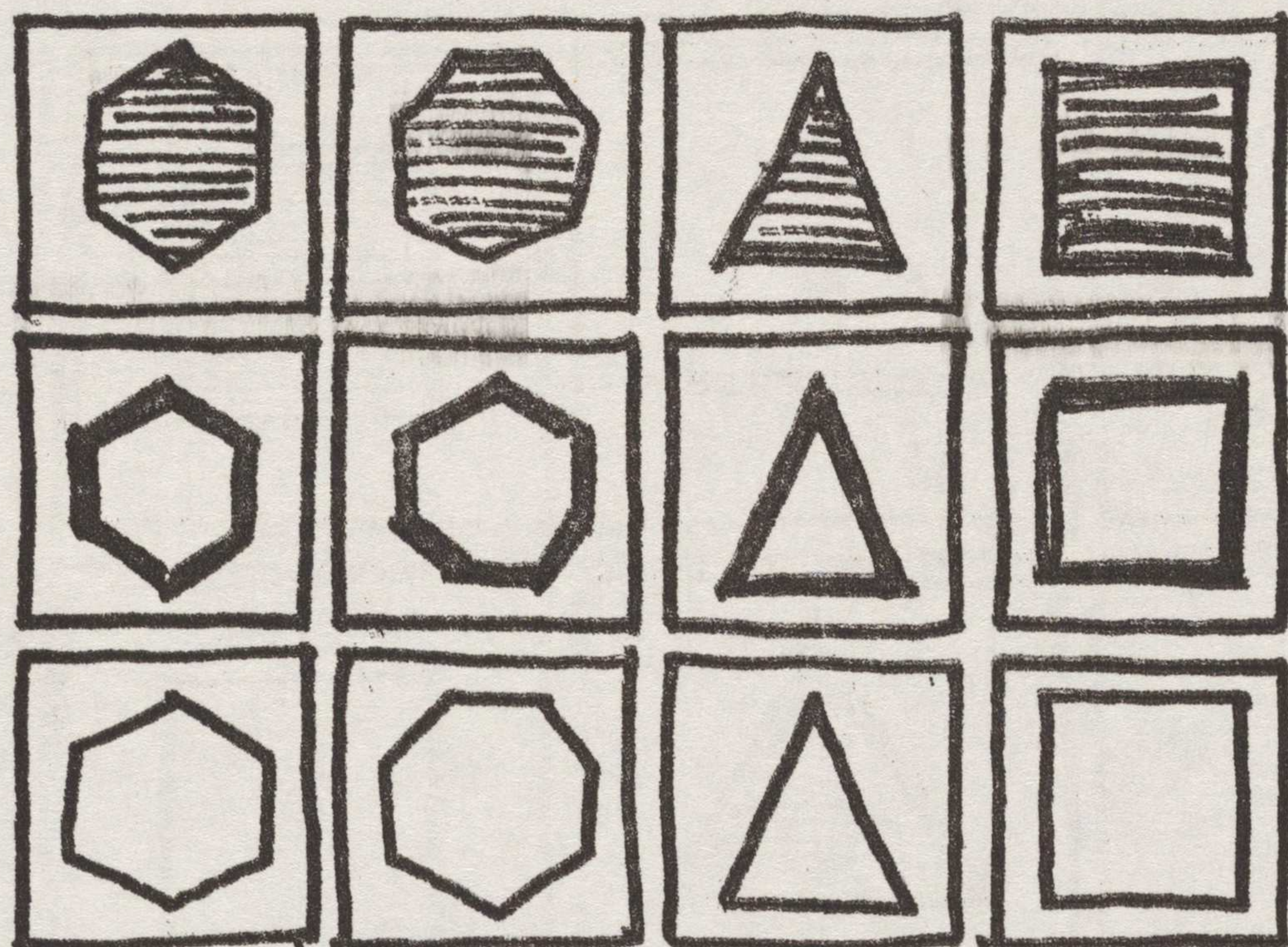
CONTROL OF ERROR

Visual: with the first box, the heavy black border; with the second box, the length of the side.

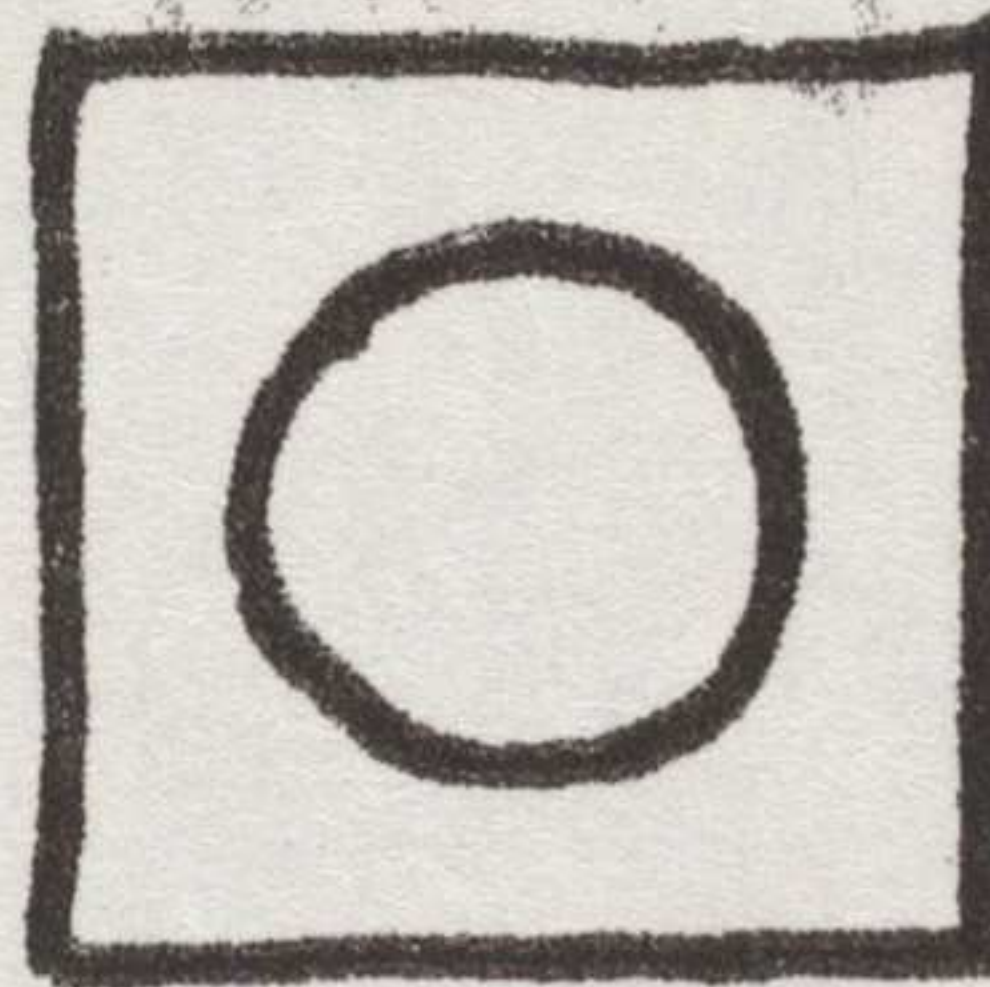
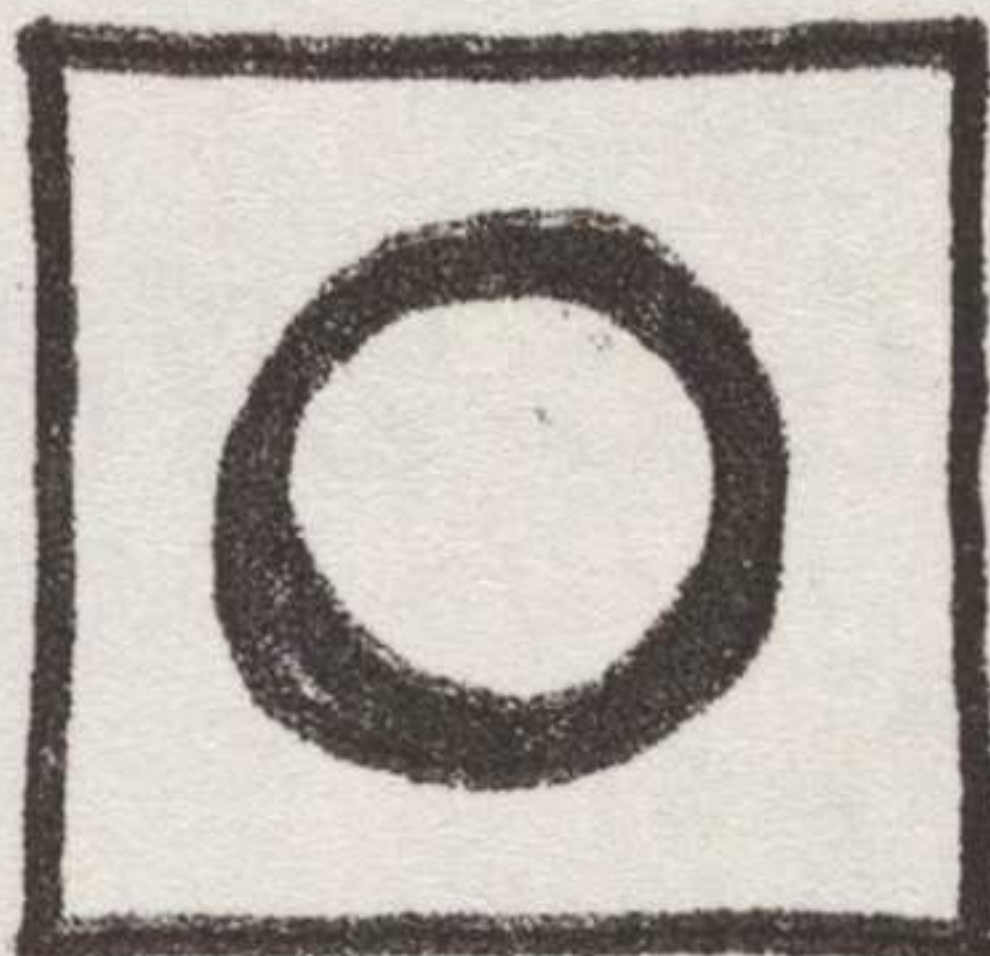


Box II

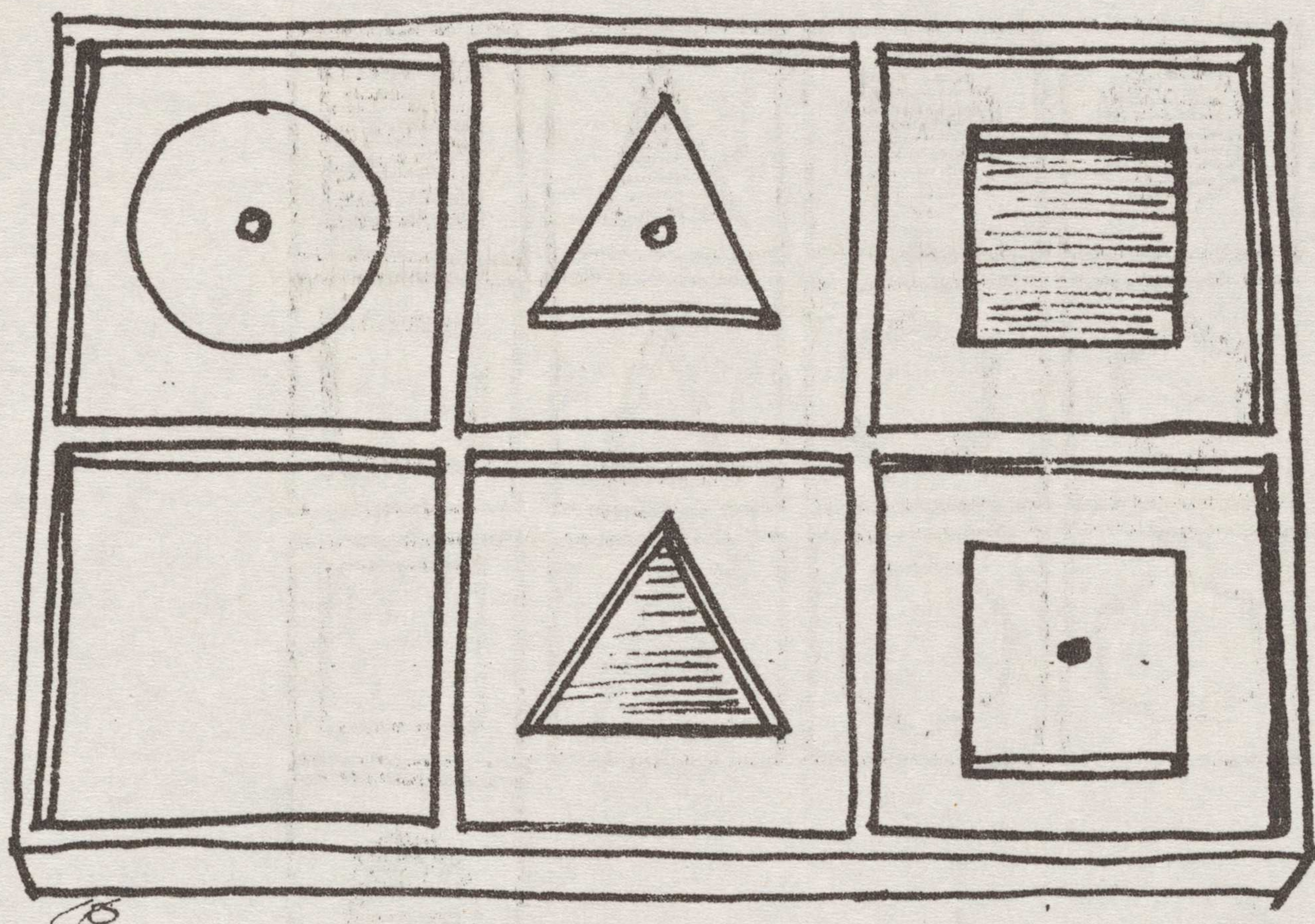




*Geometric
Cabinet Cards*



B



Geometric Cabinet
Demonstration Tray

CONSTRUCTIVE TRIANGLES - TRIANGULAR BOX

MATERIAL

One equilateral triangle colored grey. Two right-angled triangles that are equal in all respects (i.e., congruent) and are colored green. The side opposite the vertex is half the length of the side of the equilateral triangle and the adjacent side is equal to the height of the equilateral triangle. It follows that the hypotenuse must equal one of the sides of the equilateral triangle. The sum of the areas of the triangles equals the area of the equilateral triangle. The adjacent side of each of the triangles is outlined by a heavy black border.

Three obtuse-angled isosceles triangles that are identical in all respects or congruent. The sum of the areas of the three triangles equals the sum of the equilateral triangle. The two sides that include the obtuse angle are outlined by a heavy black border. All three triangles are painted yellow.

Four equilateral triangles the sum of whose areas is equal to the area of the first mentioned equilateral triangle. Each of the four triangles is congruent to the others and is painted red. One of the sides of each triangle is outlined by a heavy black border.

DIRECT AIM

To construct equilateral triangles.

INDIRECT AIM

Preparation for geometry.

PRESENTATION

1. Place the box of triangles on a rug on the floor.
2. Remove all of the triangles from the box and mix them.
3. Pick out the grey-colored equilateral triangle and set it apart from the others.
4. Construct equilateral triangles out of the triangular components of the same color always insuring that any two black-bordered sides are tangential to each other. Use the grey triangle as a control device.

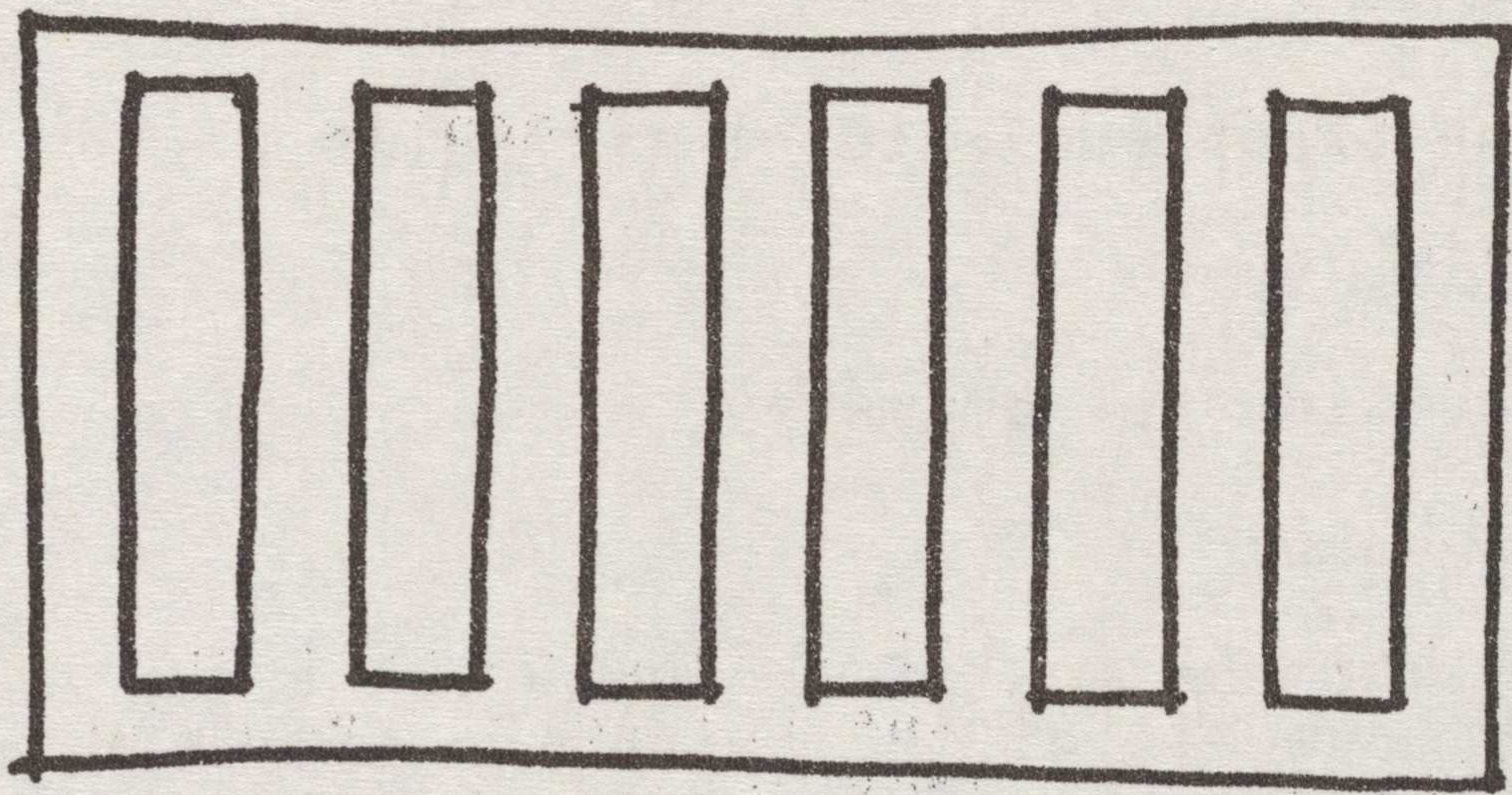
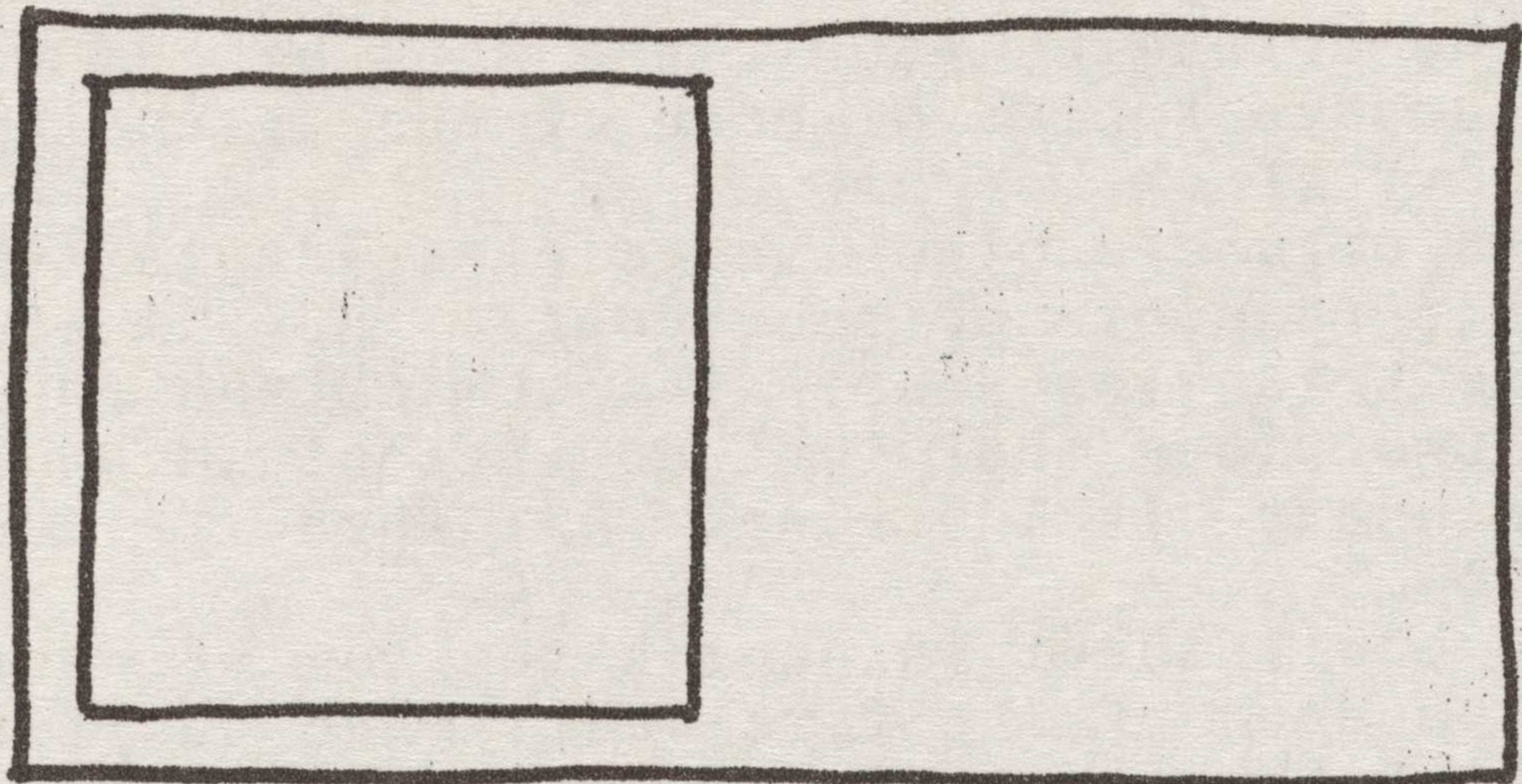
LATER EXERCISES

1. Viewing each of the constructed triangles as one equilateral triangle introduce language that will describe the geometrical terminology for the black lines within the triangle, e.g., perpendicular height or axis of symmetry, bisector, and median.

AGE 4 years and up.

CONTROL OF ERROR

Visual - the grey triangle and the black borders.



Rough & Smooth Boards

ROUGH AND SMOOTH BOARDS

MATERIAL

Four rectangular boards as follows:

1. A board divided into two equal squares one of which is covered with sand paper and the other of which is either highly polished or covered with smooth paper.
2. A board divided into 9 rectangular strips that alternate in texture from smooth to rough.
3. A board divided into 11 rectangular strips that are graded in rough surface.
4. A board divided into 11 rectangular strips that are graded in smooth surface.

DIRECT AIM

To develop the tactile sense and to control muscular action by the lightness of touch.

INDIRECT AIM

Preparation for writing.

PRESENTATION

1. Wash your hands and dry on a towel.
2. Using the first board, with eyes closed stroke lightly with fingertips in a downward movement first the smooth surface then the light surface. Repeat several times, always emphasizing the lightness of touch required.

LATER EXERCISES

1. Repeat this exercise on board 2 using for each strip the index and middle fingers.
2. Repeat the exercise on board 3 and then on 4.
3. After this experience with the various boards, introduce language: ROUGH, SMOOTH; ROUGHER, SMOOTHER; ROUGHEST, SMOOTHEST.

AGE From 2-1/2 to 3-1/2 years.

CONTROL OF ERROR

Visual.

OTHER MATERIAL FOR TRAINING THE TACTILE SENSE

MATERIAL

1. Rectangular tablets, all of the same dimensions, but covered with sandpaper of varying grades of roughness. Two tablets to each sandpaper grade.
2. Rectangular tablets, all of the same dimension, but covered with varying grades of fine sandpaper. A pair of tablets to each sandpaper grade.
3. A number of rough fabrics, square in shape and of the same size. Two pieces to each kind of fabric. Match by feeling.
4. A number of smooth fabrics, square in shape and of the same size. Two pieces to each kind of fabric.

DIRECT AIM

To develop the tactile sense and to control muscular action by the lightness of touch.

INDIRECT AIM

Preparation for writing by means of material (1) and (2).

PRESENTATION

1. Before introducing material (1), wash hands and dry briskly on a towel to make fingertips sensitive to touch.
2. Mix the tablets and, blindfolded, pair them by grades.
3. Invite the child to do the exercise by himself.

LATER EXERCISES

1. Present material (2) in the same manner as described above.
2. Introduce material (3), mix and then pair the fabrics while blindfolded.
3. Present material (4) in the same manner.
4. Give names of the materials used in exercises (3) and (4), e.g., velvet, silk, burlap, etc.

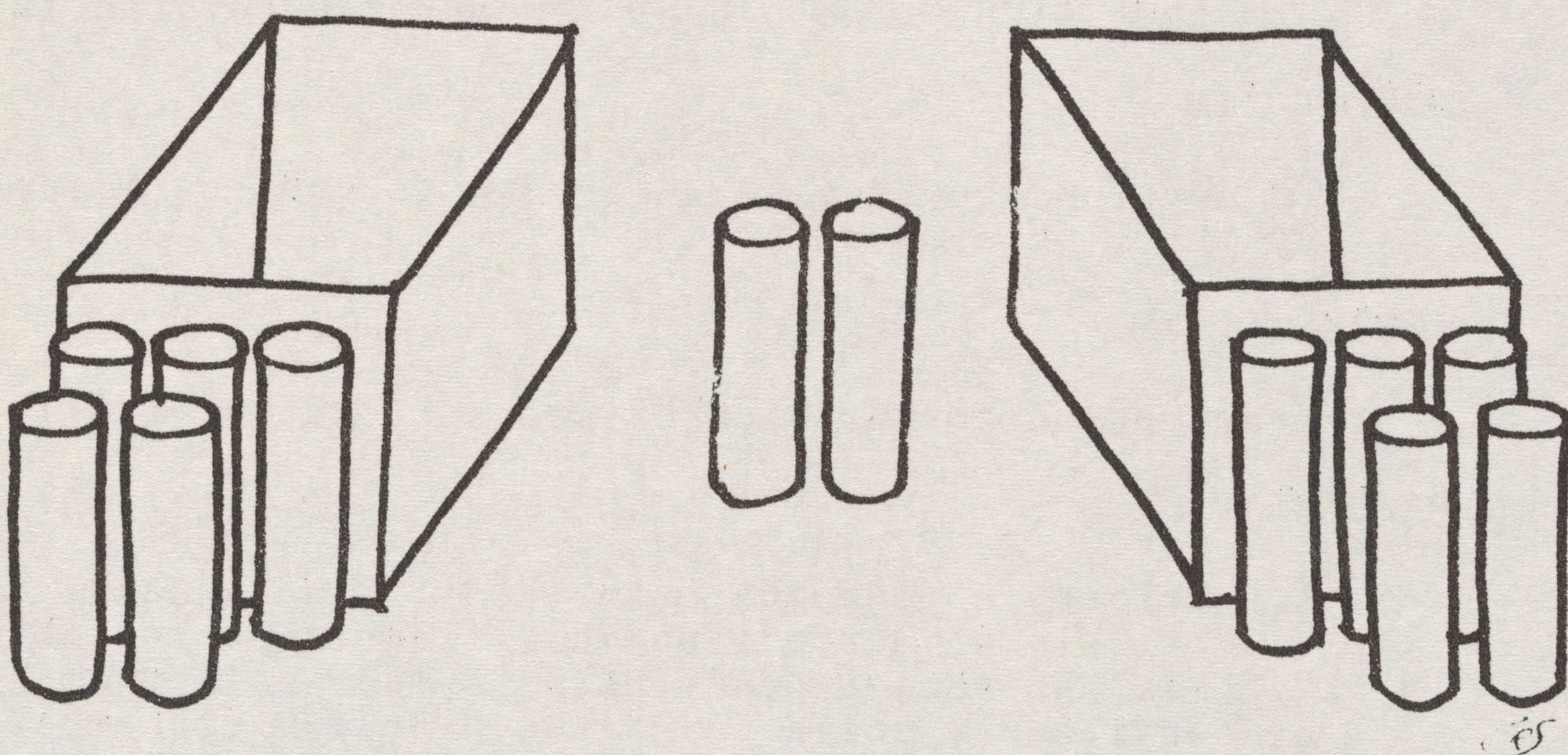
AGE 2-1/2 to 3-1/2 years.

CONTROL OF ERROR

Visual.

POINTS OF INTEREST

1. Light touch; Use tips of fingers.
2. Begin with greatest differences in roughness and smoothness. Work up to finer discriminations.
3. Refer to control often, after each time you rub board.



Sound Boxes

SOUND BOXES

MATERIAL

Two rectangular boxes, each containing a set of six hollow cylinders. Each cylinder has a small quantity of beads or similar material in it such that when shaken it will produce a sound. The two sets are distinguished from each other in that the tops of the cylinders in one set are all painted blue, while the tops of the other set of cylinders are painted red. Within either set, each cylinder when shaken will produce a different sound from any of the other cylinders within that set. For each cylinder with a given sound in the one box there is a cylinder in the other box that will produce the same sound. A pair of cylinders of the same sound is distinguished from another pair by a colored dot on the cylinder bases, with one color to each sound.

DIRECT AIM

To develop sense of sound.

INDIRECT AIM

Preparation for musical education.

PRESENTATION

1. Select three pairs of cylinders such that the members of any one pair produce the same sound but differ in sound from pair to pair. Place these cylinders in mixed order on a table in front of the child. One of the pairs will be the one that has the loudest sound, another pair the softest sound and the third pair will be one that is ranged in sound between these two extremes.
2. From the cylinders selected choose one, the top of which is painted RED. Shake it close to each ear and then set it apart from the other cylinders.
3. Search for a blue-topped cylinder that will yield the same sound as the red one that was just selected. Do this search by trial and error, refreshing your memory after each trial as to the sound of the red-topped cylinder that was first selected. Set each pair of cylinders of the same sound apart from the other pairs. This exercise is completed after the six cylinders are matched into three pairs the two members of any one of which have the same sound.

LATER EXERCISES

1. Introduce more cylinder pairs until all six pairs have been employed.

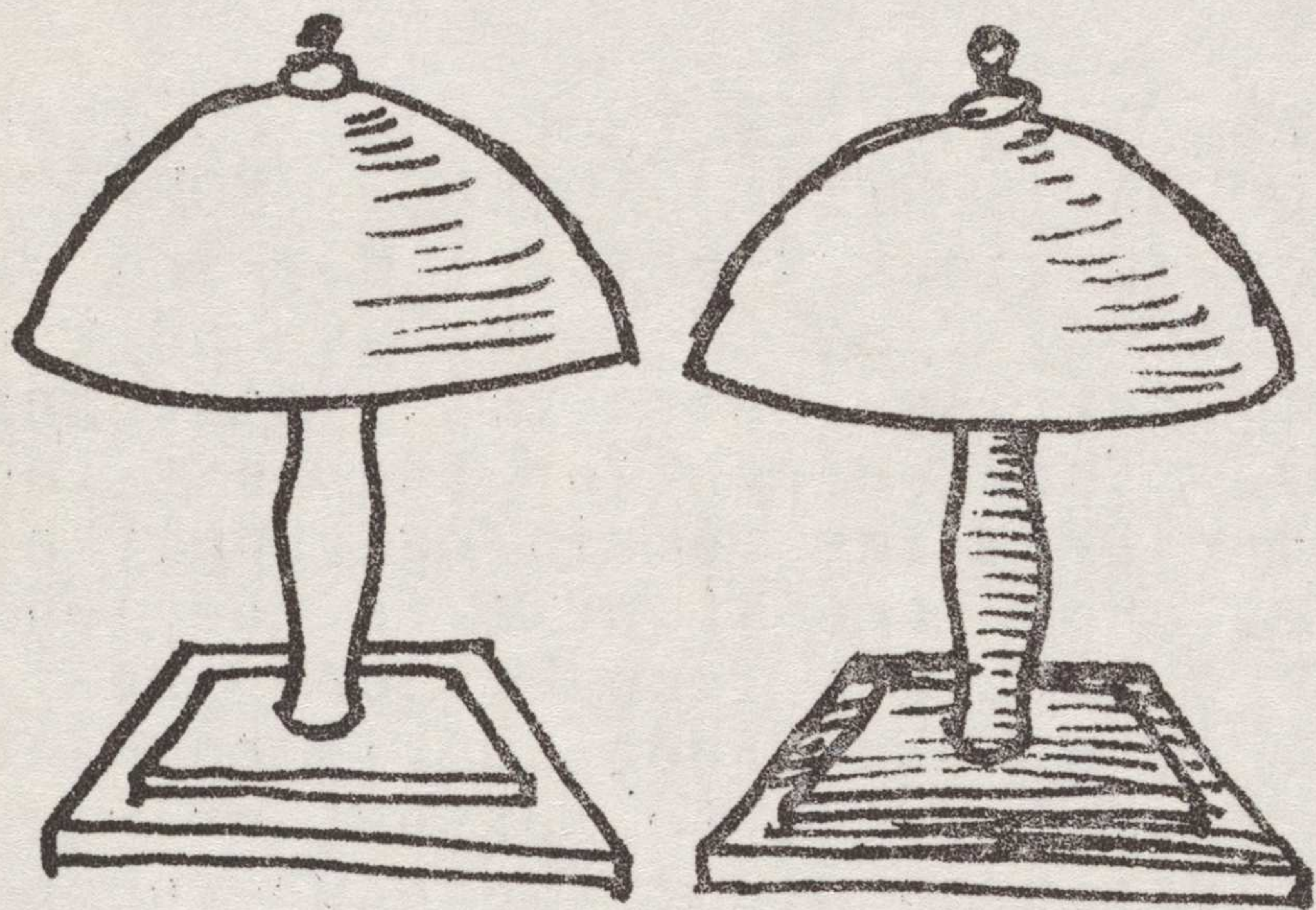
SOUND BOXES - CONTINUED

2. Introduce language using the three period lesson: LOUD, SOFT; LOUDER, SOFTER; LOUDEST, SOFTEST.
3. Introduce the graduation exercise. Working with the red-topped cylinders, find the loudest and the softest cylinders first, setting them a small distance apart from each other. Then search for the next loudest sounding cylinder from the remaining supply of red-topped cylinders and place it next to the loudest cylinder and in a straight line between the first selected pair. After the gradation is completed, test it in sequence from loudest to softest or vice versa. Then invite the child to grade the blue-topped cylinders using the gradation of the red-topped cylinders as a control.

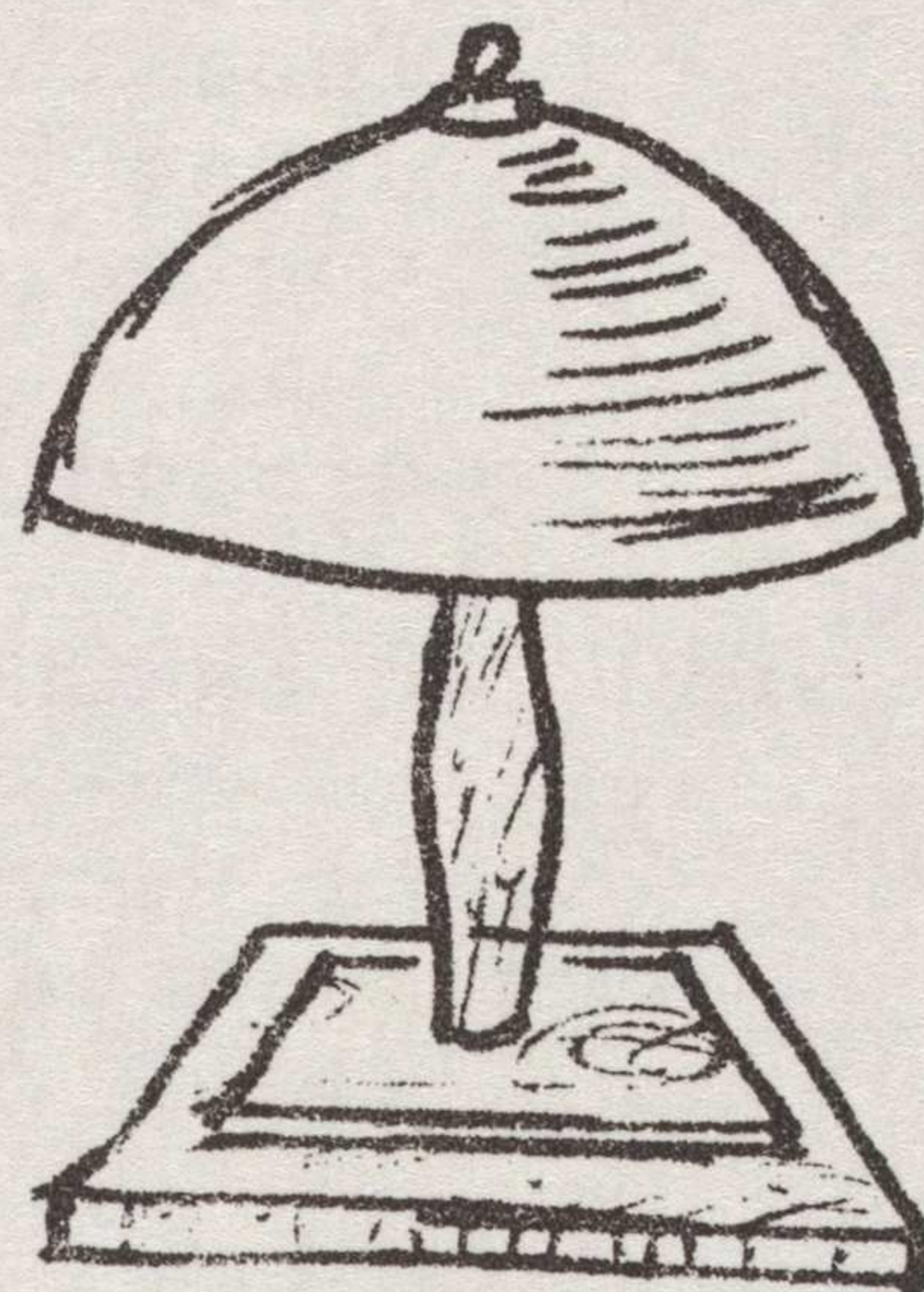
AGE Around 3 years.

CONTROL OF ERROR

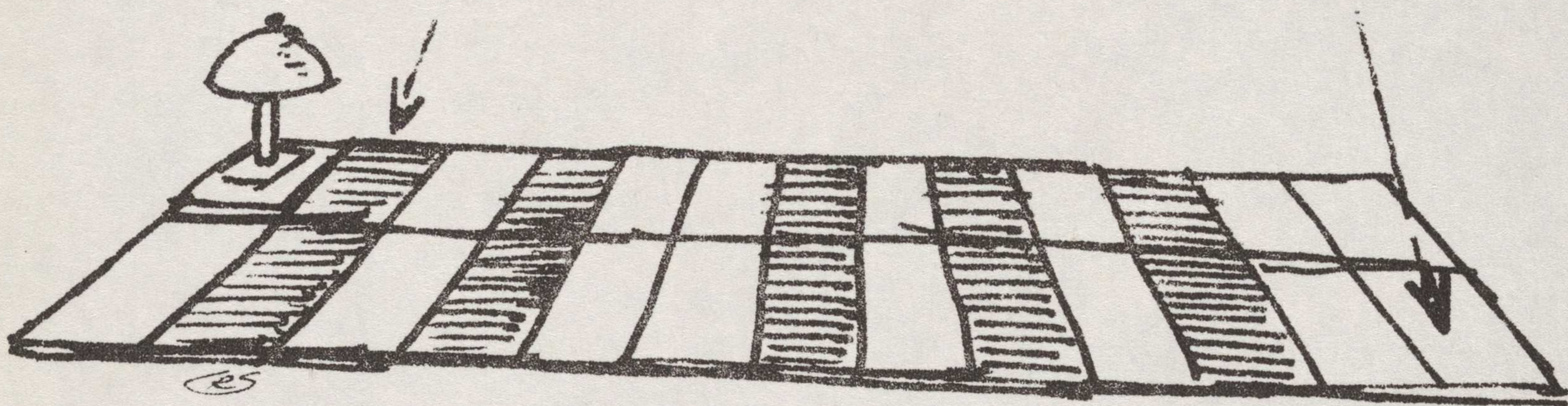
Visual - cylinders of the same sound have the same colored dot painted on their bases.



Control Bells



Working Bell



Bells

BELLS**MATERIAL**

Two series of bells ranging from Middle C to High C. The one series has black and white wooden stands for semi-tones and tones, respectively, while the other series of bells has plainly varnished wooden stands irrespective of tone. A rectangular board painted to resemble in part the piano keyboard. A small wooden hammer. A felt-covered piece of wood to be used as a muffler. A staff board with notes represented by circular holes. The bottom of each of these holes is marked by a black-on-white printed number. Eight circular discs (that fit into the holes) each one of which is marked by a number on one side and the name of a note on the other side.

DIRECT AIM - To train the musical mind.

INDIRECT AIM - preparation for musical education.

PRESENTATION

Remove all semi-tones from the rectangular board before beginning the presentation.

1. Select from the two series two pairs of bells the members of any one of which give the same sound. Remove the two bells with the plain wooden stands from the board lifting the bell by its stem or stand.
2. Hit one of the selected "white" bells with the hammer and remember the sound. Now hit one of two selected "plain" bells. If the sound is the same as that for the white bell just tested, place it back on the board opposite its matching pair. If the sound is not the same, hit the white bell again and then the plain bell that was not tried before.
3. Perform the matching exercise for the second pair of bells in the same manner.

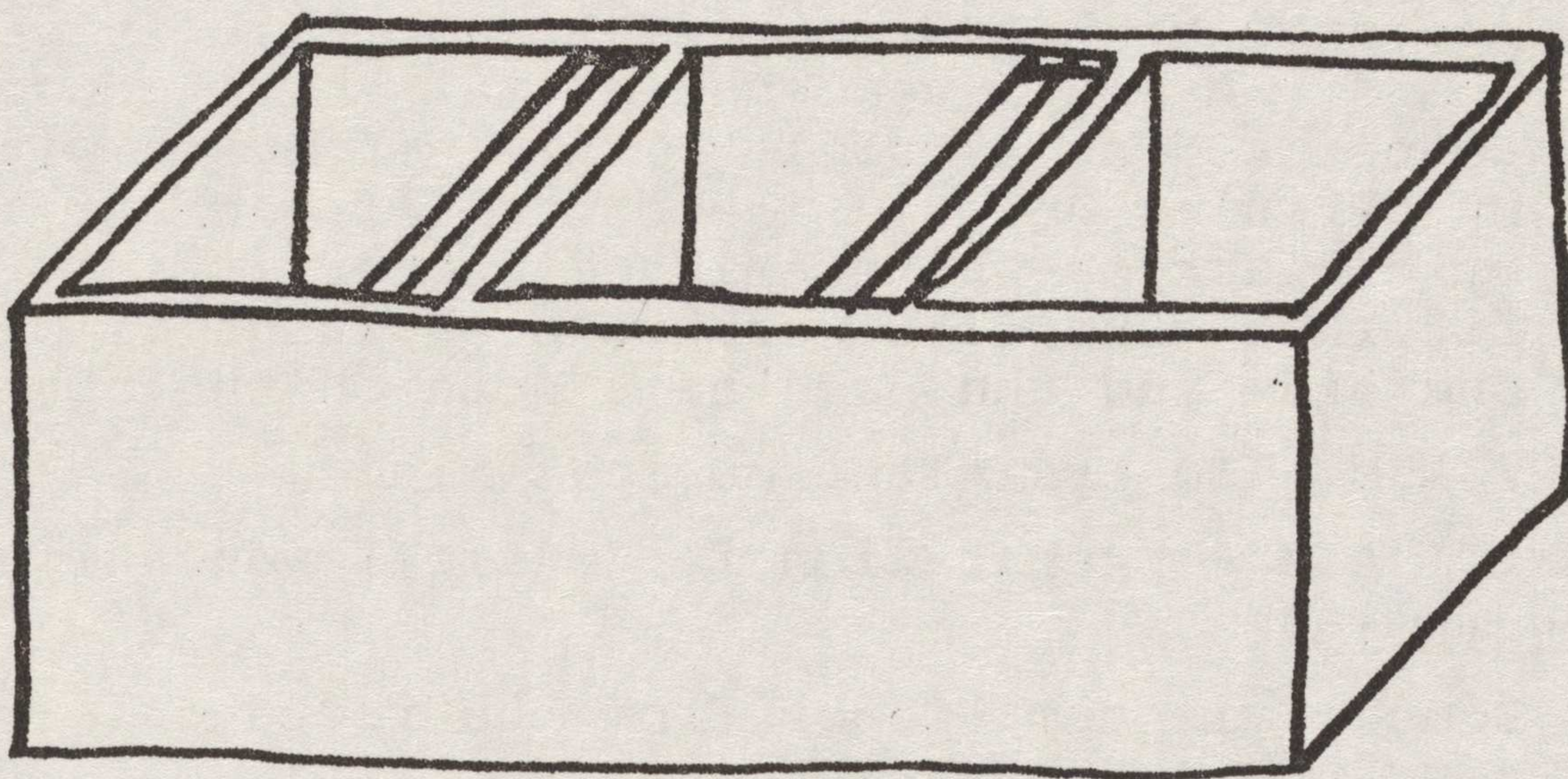
LATER EXERCISE

1. Add gradually more pairs of bells until the eight tones have been matched.
2. Play scale of C-Major to introduce the order of the notes. This can be done to the entire class at your own selected times.
3. Introduce the grading exercise using the plain bells. The white set of bells remains on the board and is to be used as a control device.
4. Introduce language, naming the sounds: Middle C, D, E, F, G, A, B, and C. (The names of isolated sounds are presented around 5 years).
5. Introduce notes in written form.
6. Associate the bell sounds with the written symbols.
7. Match all bells - tones and semi-tones.
8. Grade all bells - tones and semi-tones.

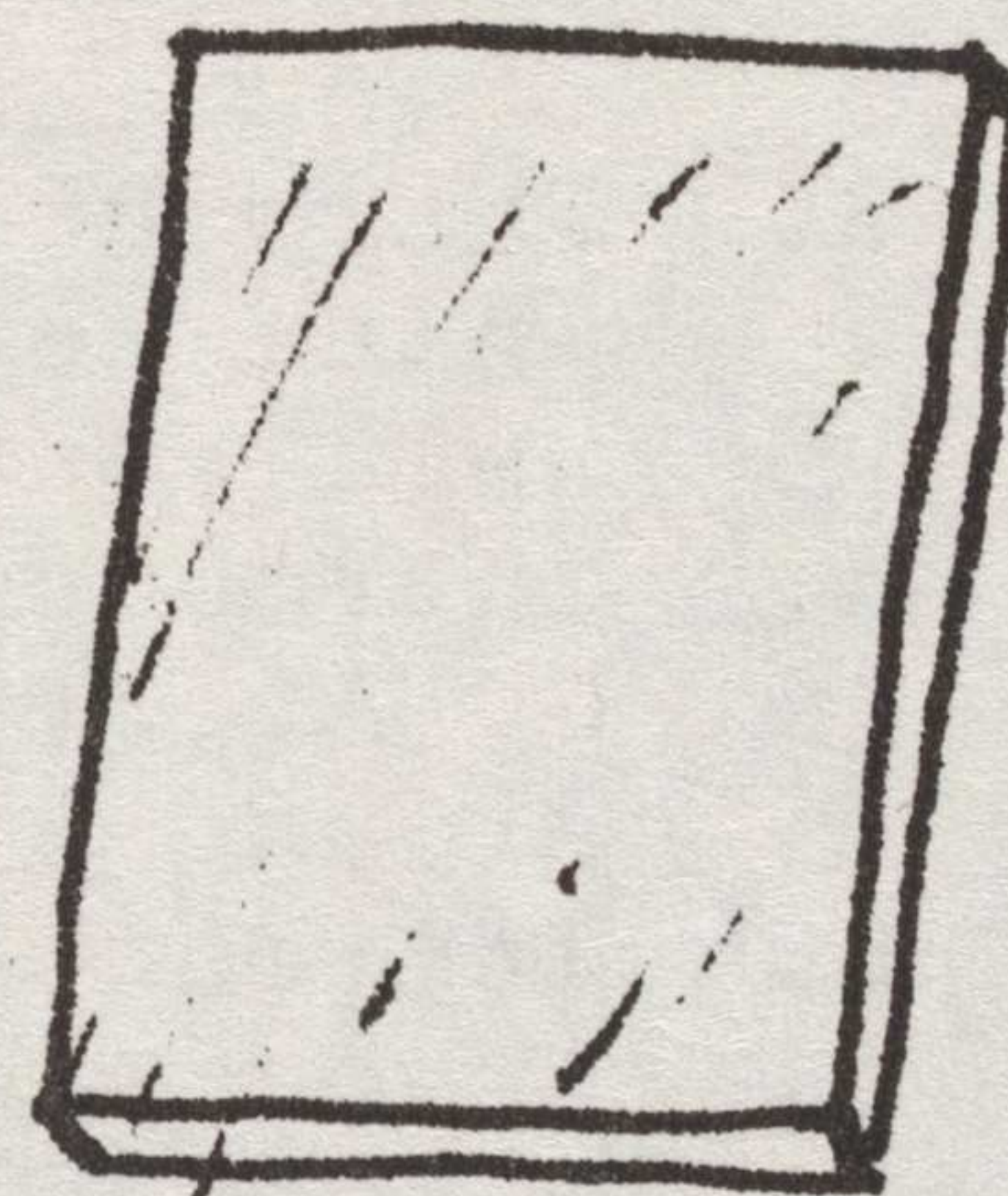
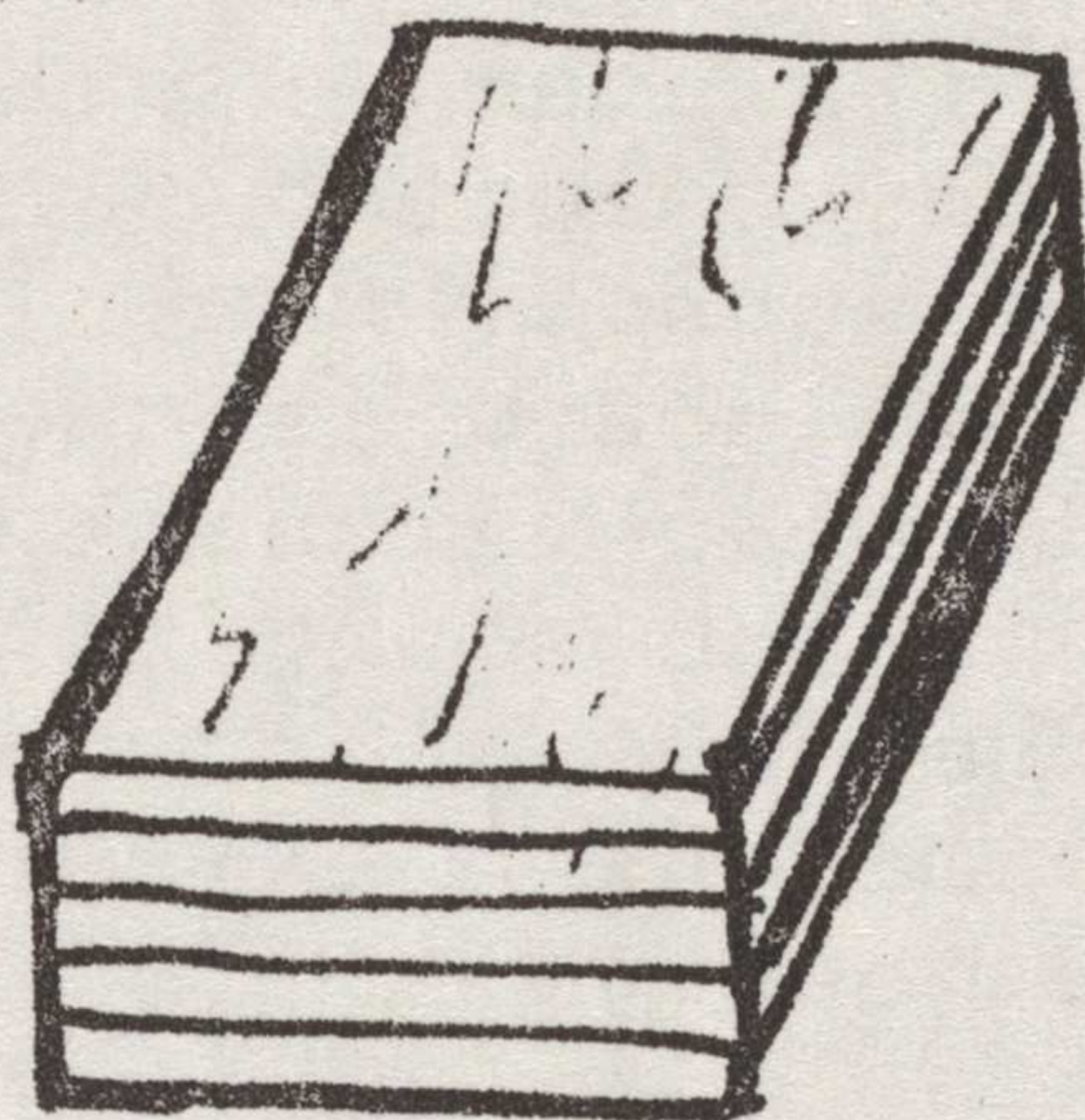
AGE 3 years and up.

CONTROL OF ERROR - Black and white-stemmed bells that remain on the board during all exercises.

NOTE: After striking a bell, use the felt-covered piece of wood to muffle the sound.



*Baric
Tablets*



BARIC TABLETS

MATERIAL

A box containing three sets of rectangular tablets, six tablets to a set, with each set made from a type of wood that differs in both weight and color from the other two types. The tablets in the three sets weigh 24gr, 18gr, and 12gr, respectively, and are of a smooth and polished texture, with the original color of the wood retained.

DIRECT AIM

To develop the baric sense.

PRESENTATION

1. Select the heaviest and the lightest of the three sets of tablets. Mix the two sets into one pile. Pick any two tablets from the pile, holding one tablet in each hand. Then compare the weights of the two tablets by placing each on the fingertips of each hand and performing a slight up and downward movement with both hands.
2. If the two tablets are of the same weight, put them into one pile, if of different weight, into different piles. Exhaust the supply of the two sets, ending up with two piles, the tablets in any one of them being all of the same weight.
3. Mix the two sets and invite the child to do the exercise by himself.

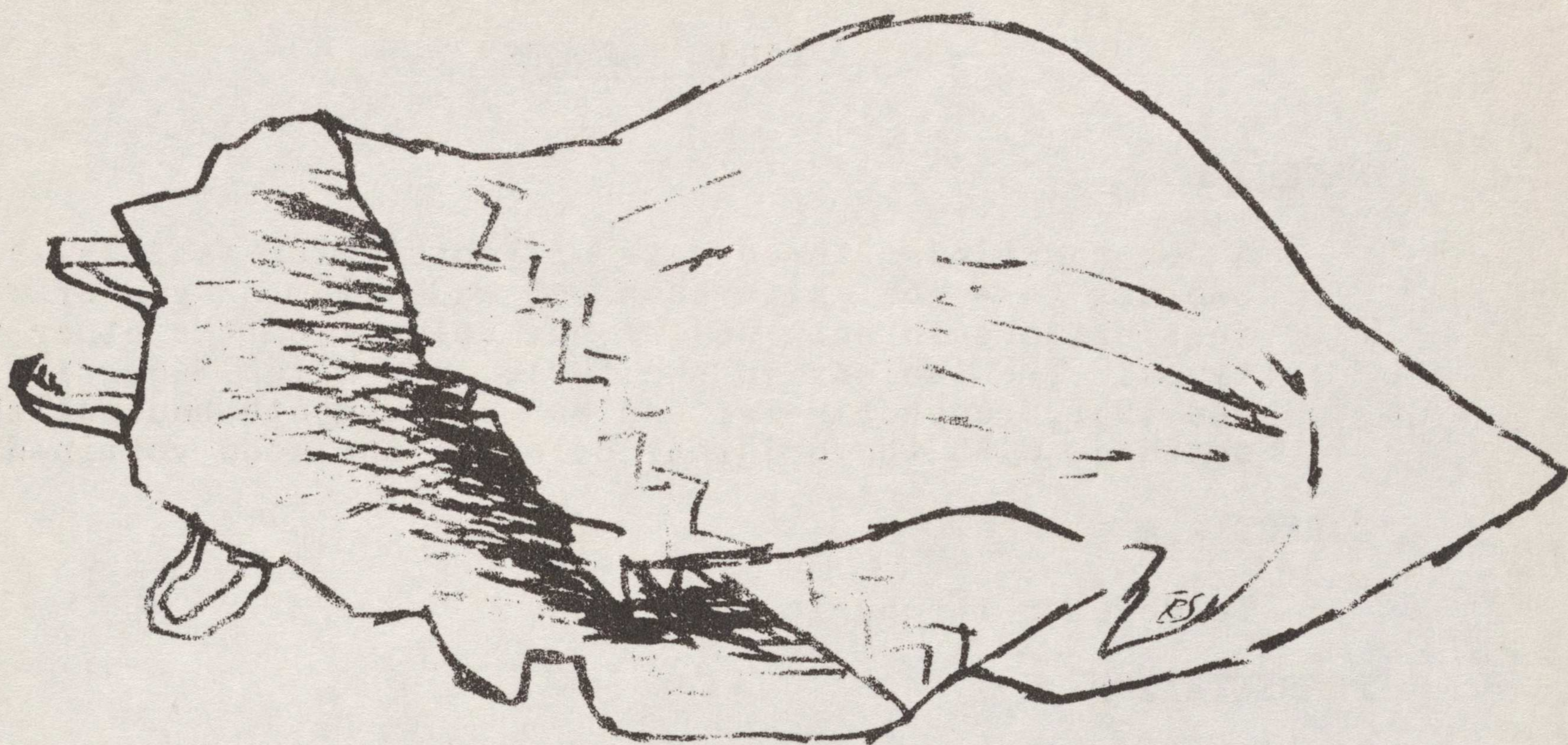
LATER EXERCISES

1. Do the exercise that was explained above while wearing a blindfold.
2. Use the three sets simultaneously in the manner described while wearing a blindfold.
3. Introduce language using the three period lesson: HEAVY, LIGHT, with comparatives and superlatives.

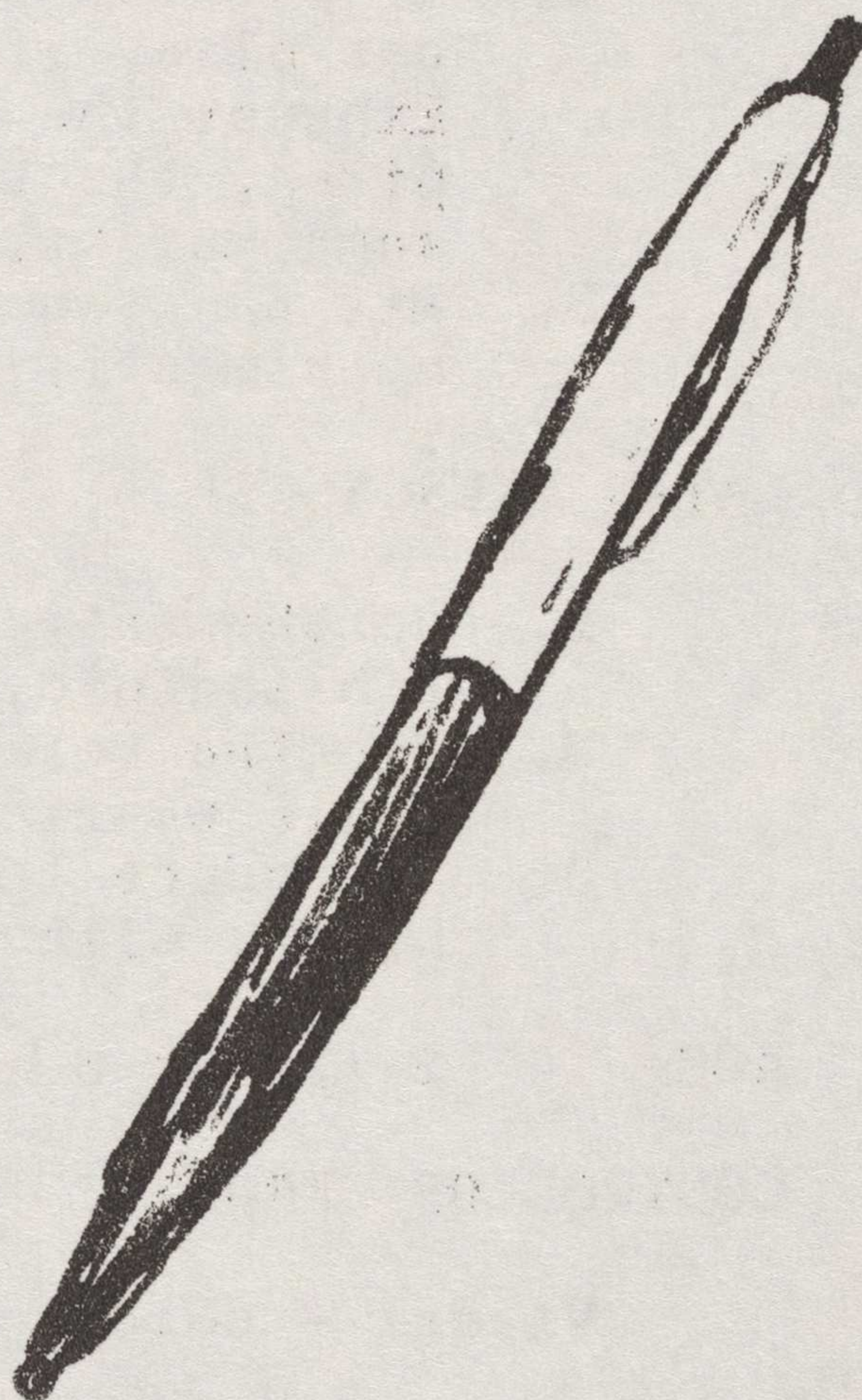
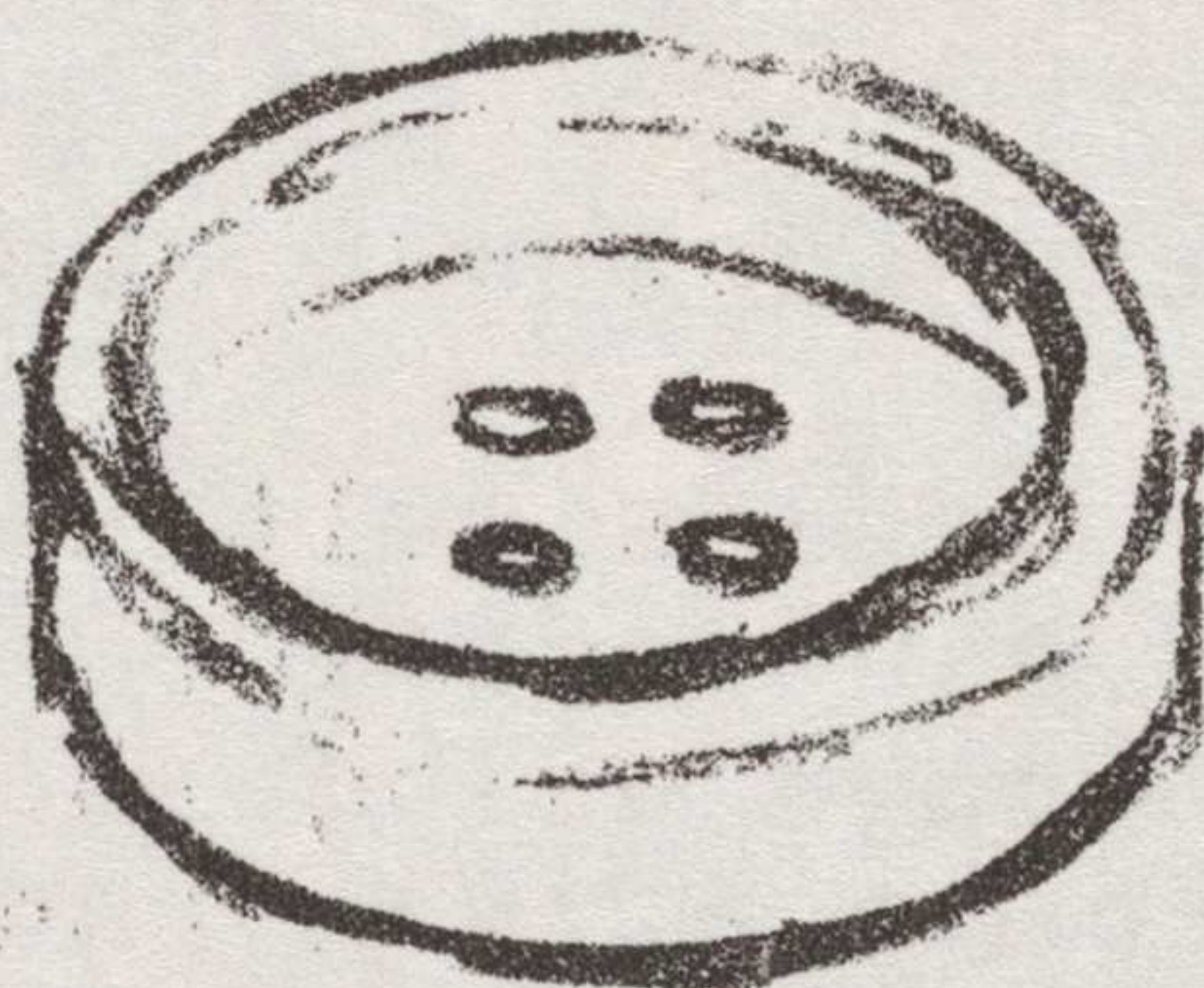
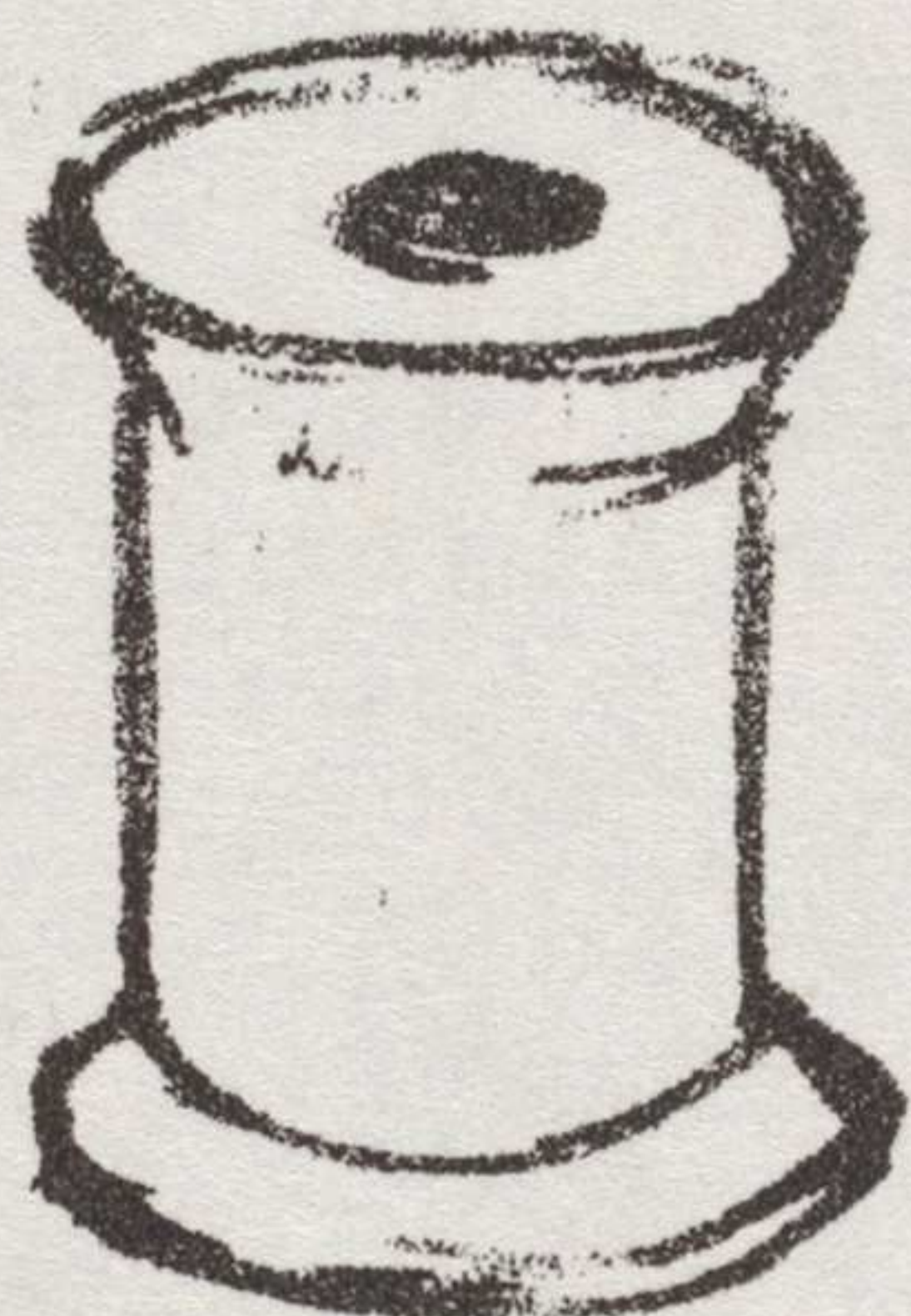
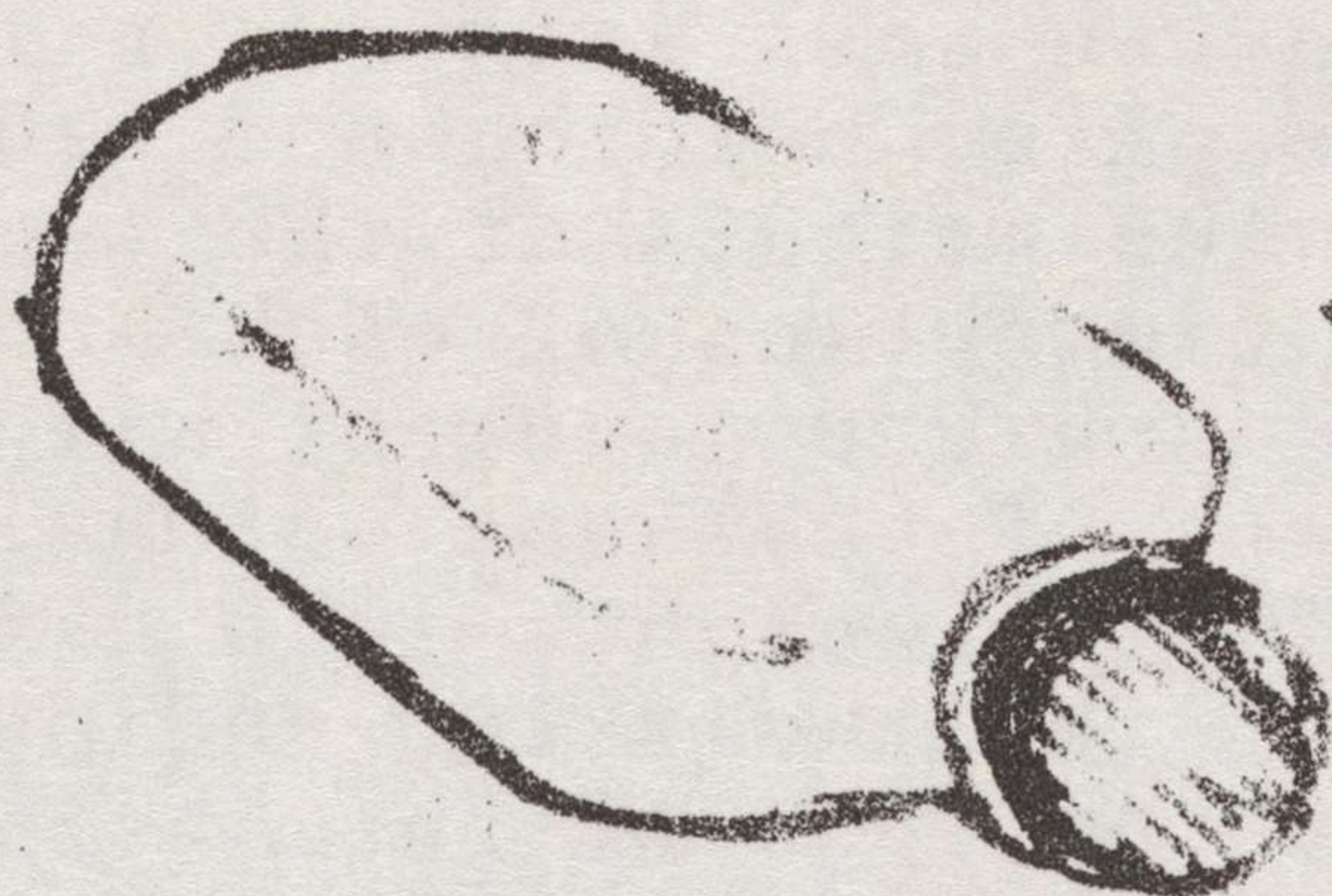
AGE 2-1/2 to 3-1/2 years.

CONTROL OF ERROR

Visual - color of wood.



Mystery Bag



STEREOGNOSTIC EXERCISES

MATERIAL

1. A container that is subdivided into one large and a number of smaller compartments. It is filled with buttons of different shape and diameter.
2. A sectioned container filled with buttons of the same shape but different diameter.
3. A sectioned container of large and small beads.
4. A mystery bag the contents of which are changed periodically.
5. A bag containing cubes, prisms and cylinders.
6. A selection of large seeds, e.g., peas, beans, cloves, each type of seed in a separate dish on a tray. One empty dish intended for mixing the seeds.
7. A selection of smaller seeds, e.g., rice, lentels, mustard, each type of seed in a separate dish on a tray. One empty dish for mixing the seeds.
8. Sensorial material: Cylinder Insets, Geometric Insets and Geometric Solids.

DIRECT AIM

To develop stereognostic sense.

PRESENTATION

1. With sectioned container: Mix the buttons or beads in the large compartment. Then sort all buttons or beads of the same kind into its own separate compartment. As soon as the child understands this procedure, do the same while blindfolded. Finally, invite the child to do the exercise by himself while blindfolded.
2. With bags: after having made sure the child knows the names of the objects and demonstrated to him the procedure, have the child draw from the bag one object at a time and name it before he brings it into view. The bag obviates the necessity for blindfolding.

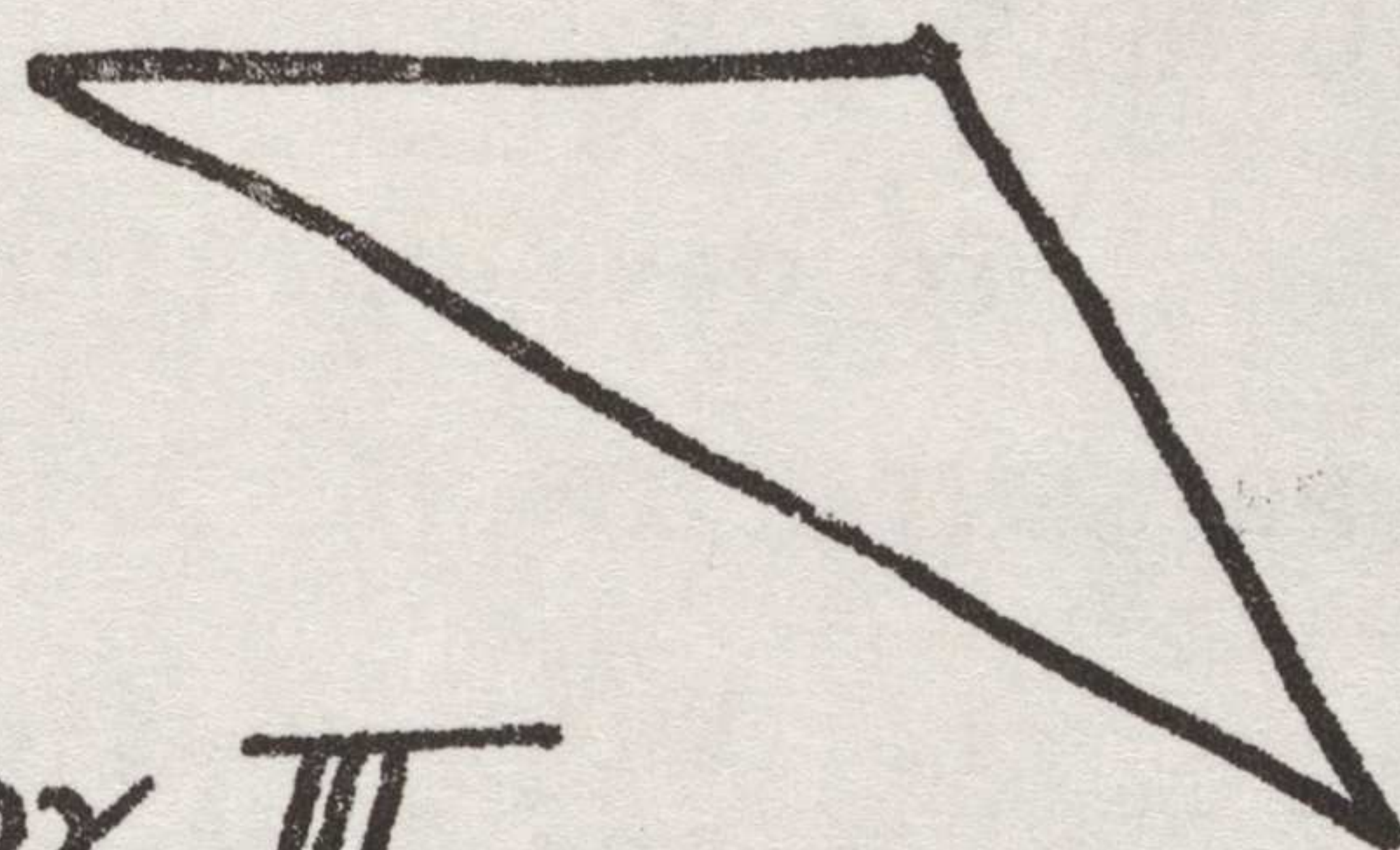
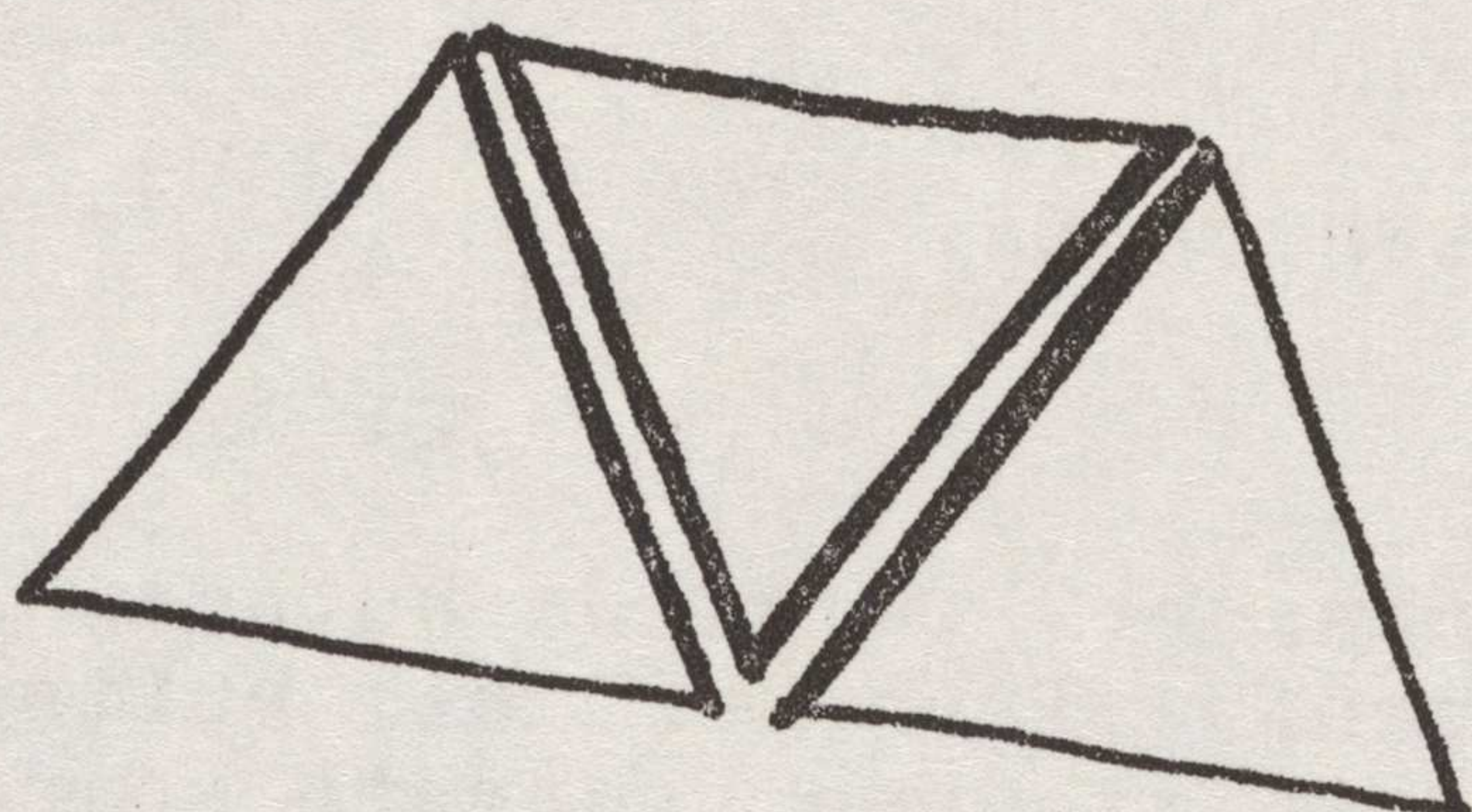
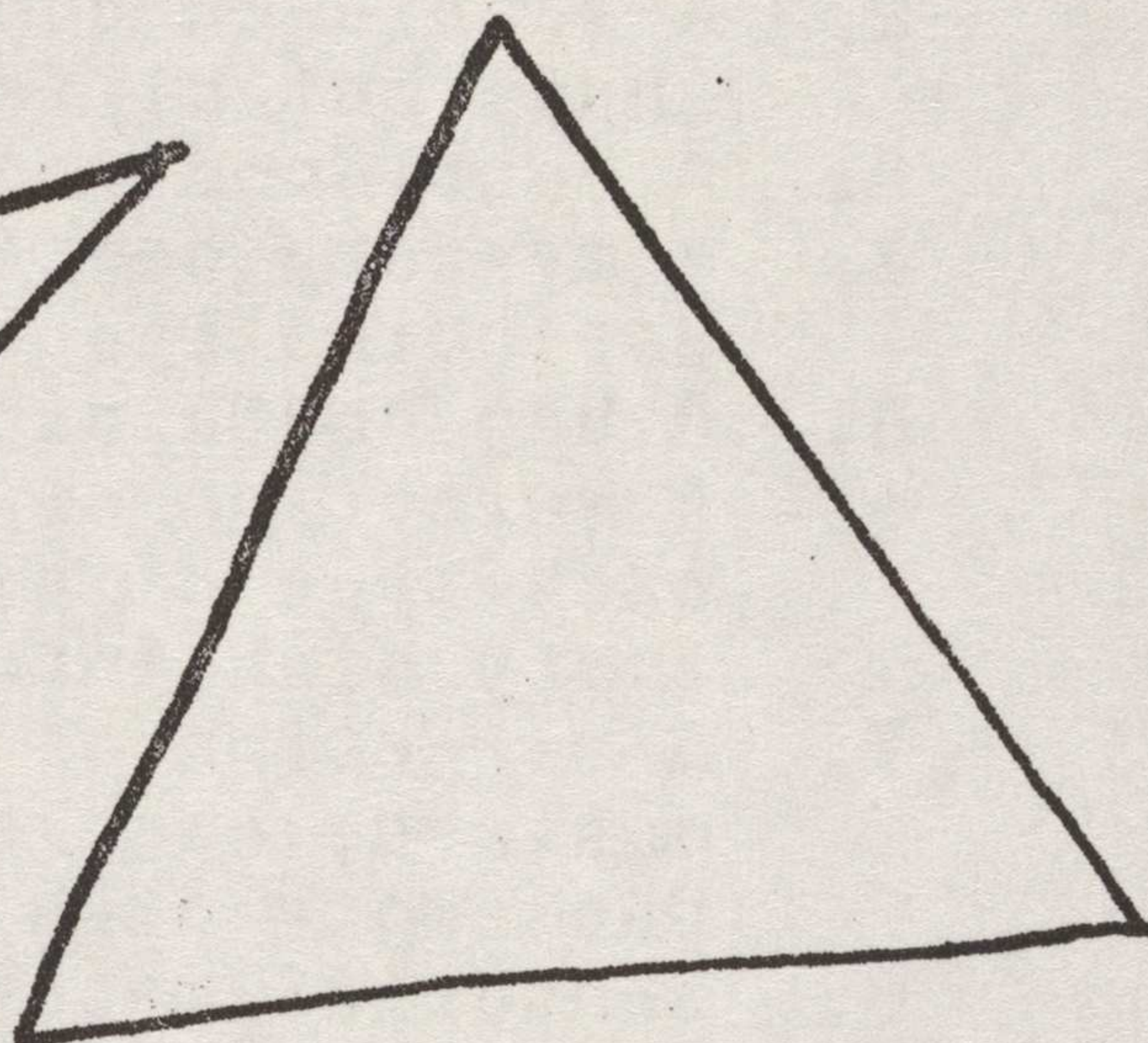
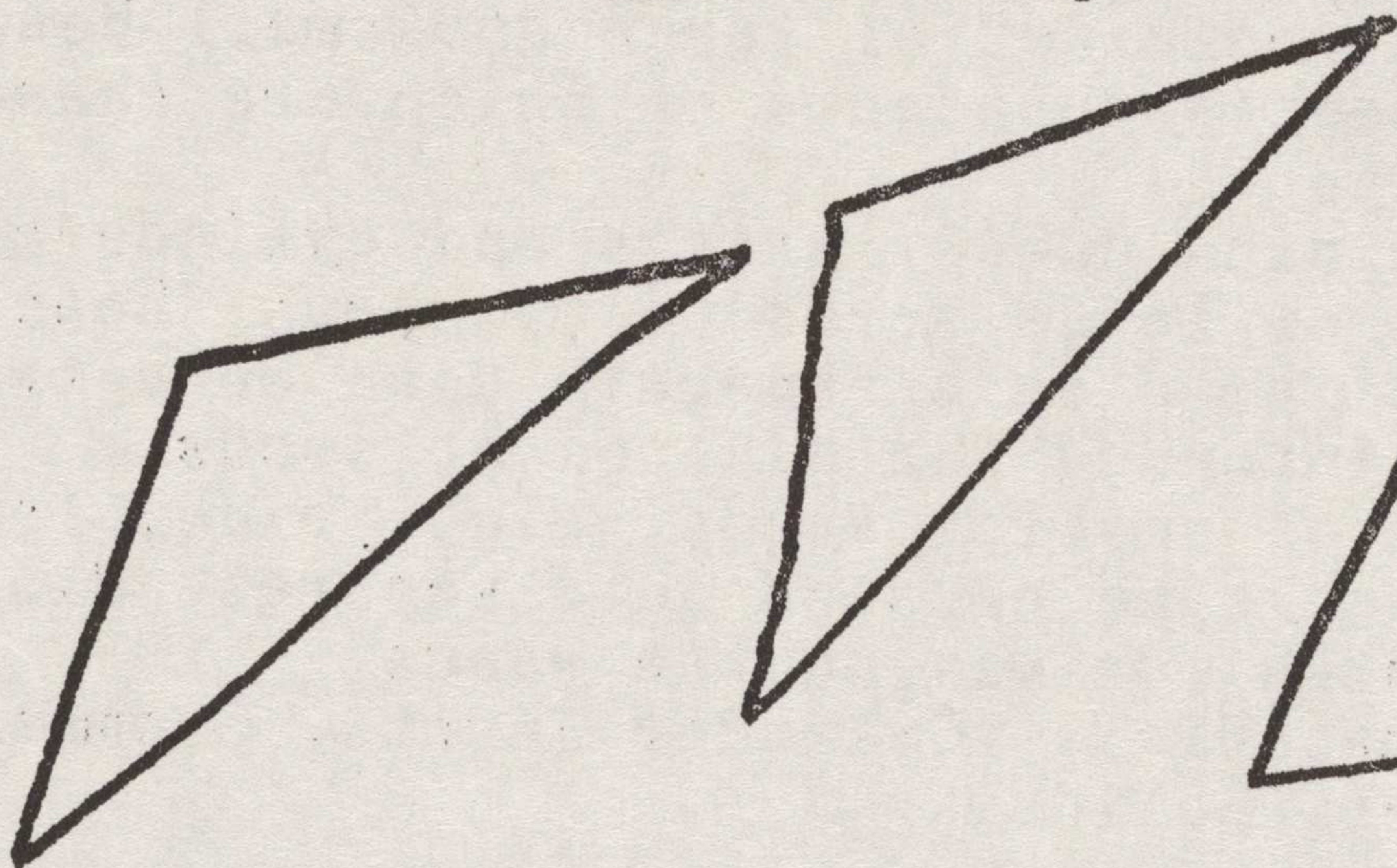
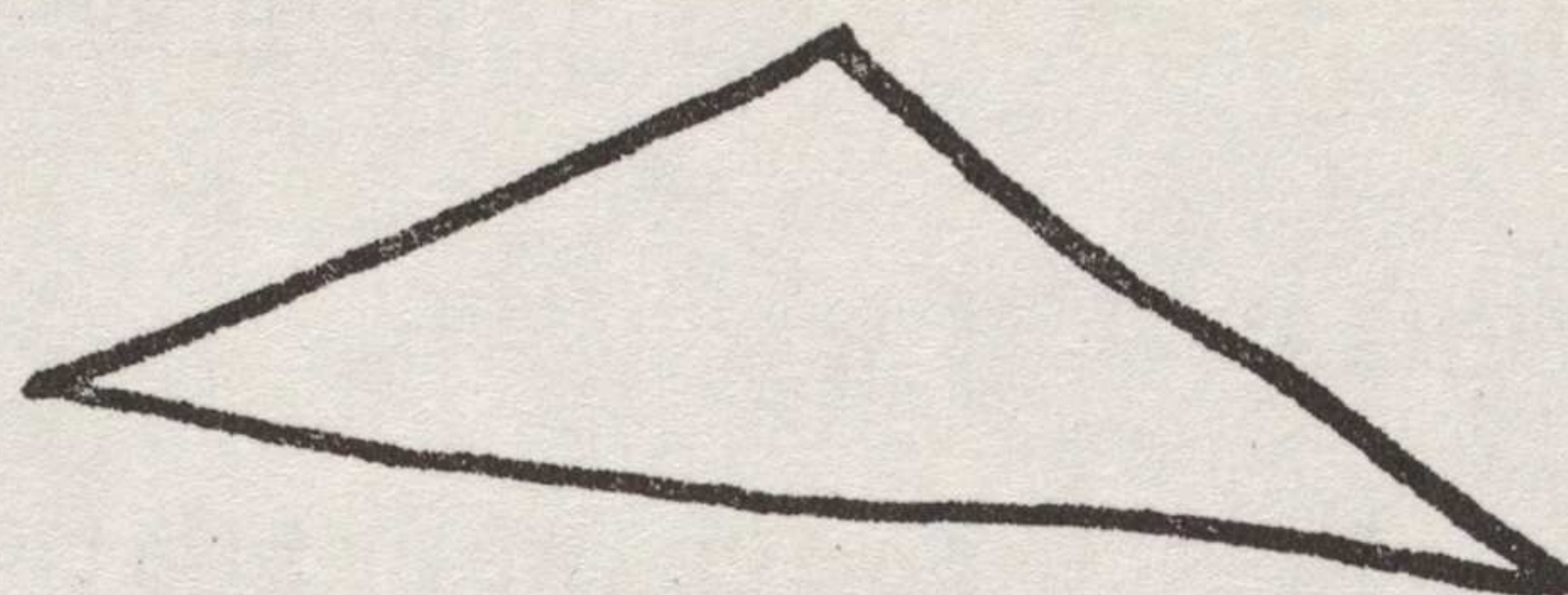
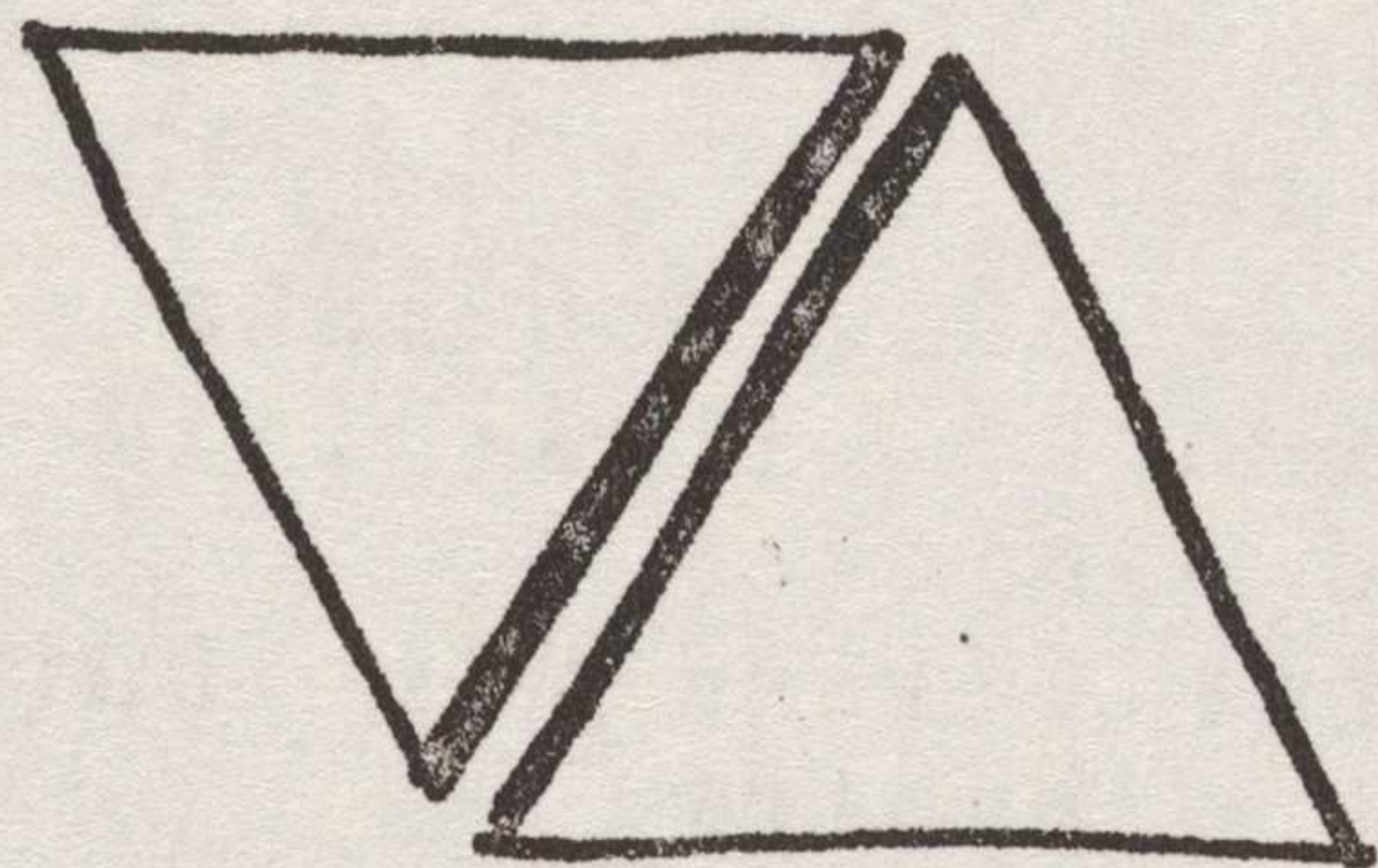
LATER EXERCISES

1. With trays: remove all seeds but one from the dishes and mix them in the separate dish provided for this purpose. While blindfolded, sort the seeds into their proper dishes.
2. With Sensorial Material: while blindfolded, do the exercises with these materials as previously explained.

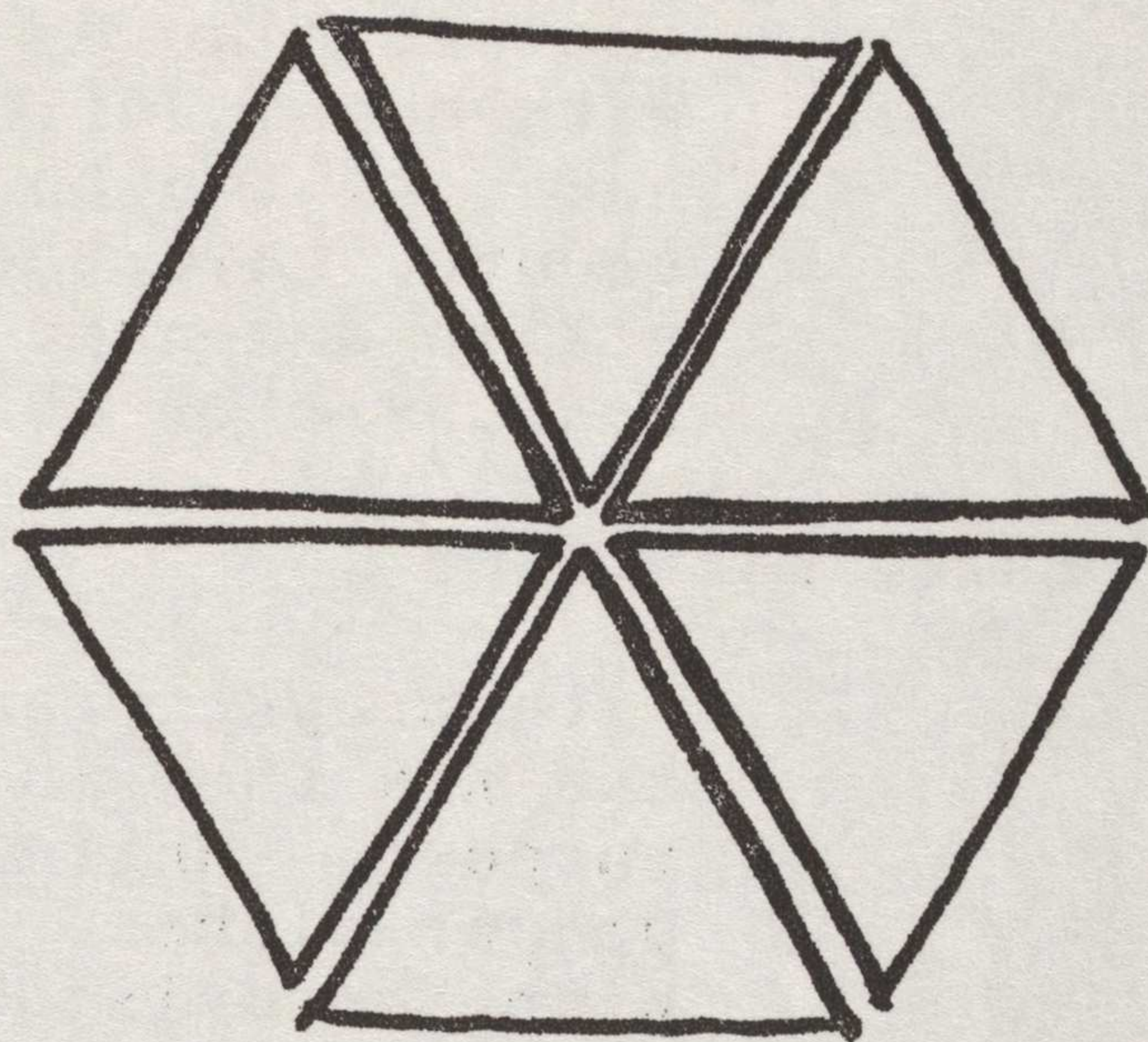
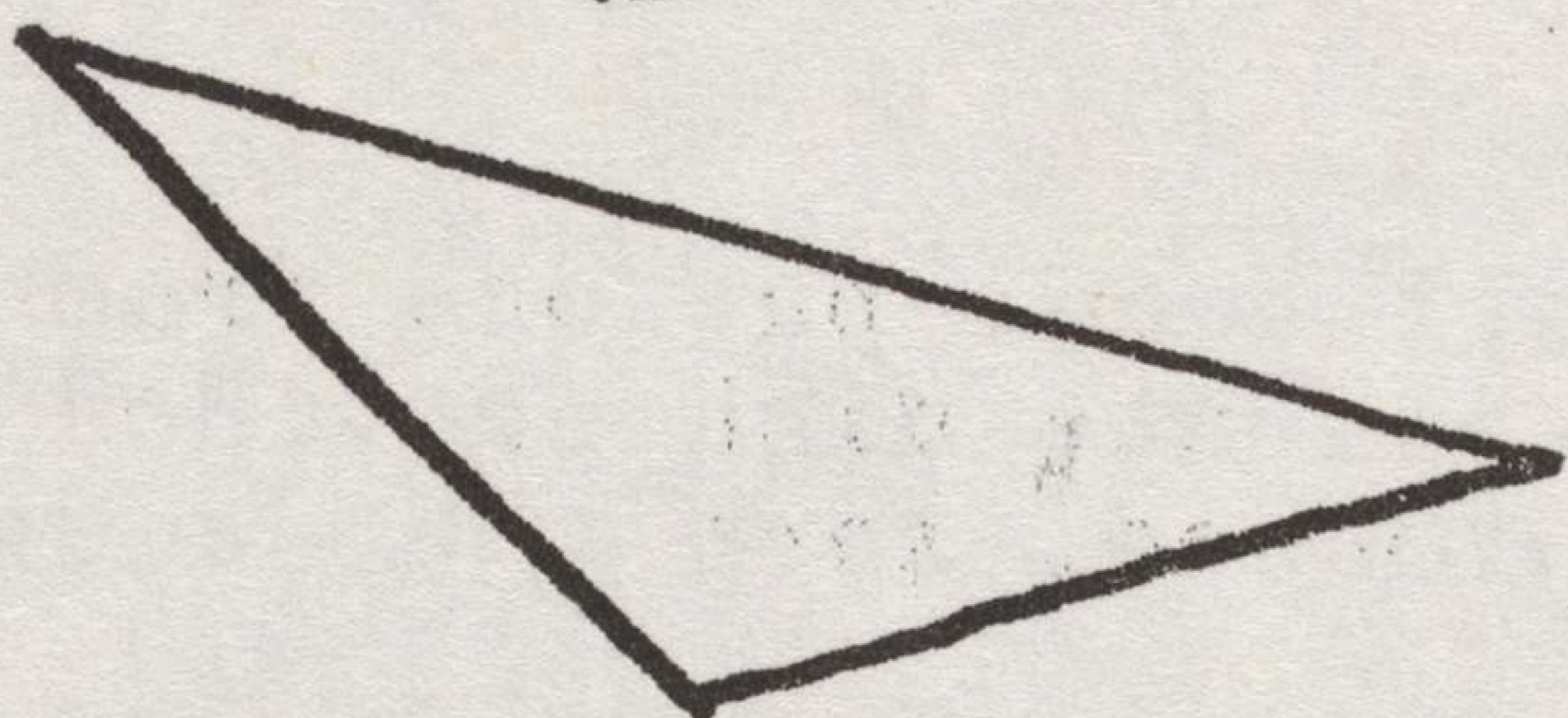
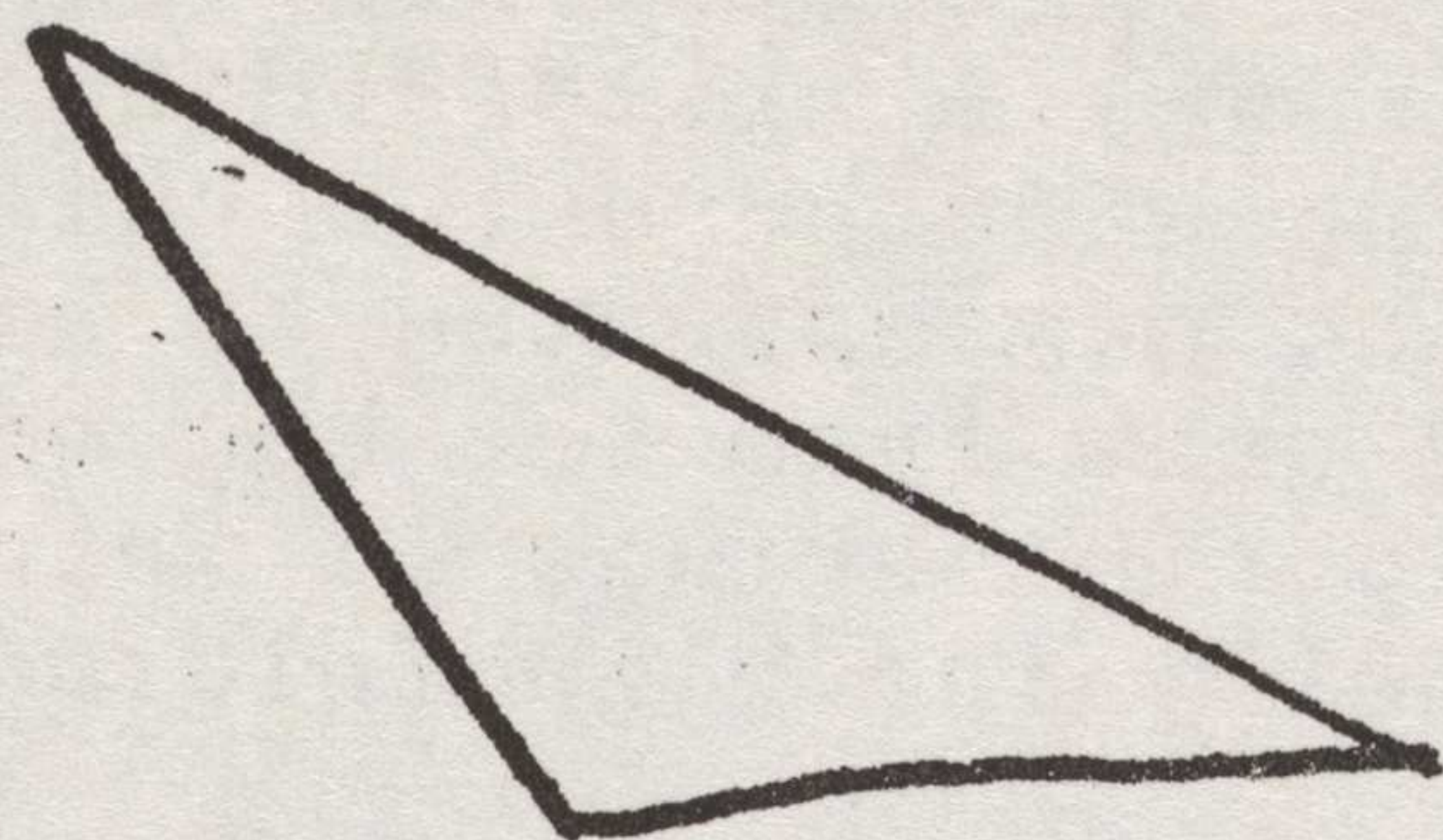
AGE 3-5 years.

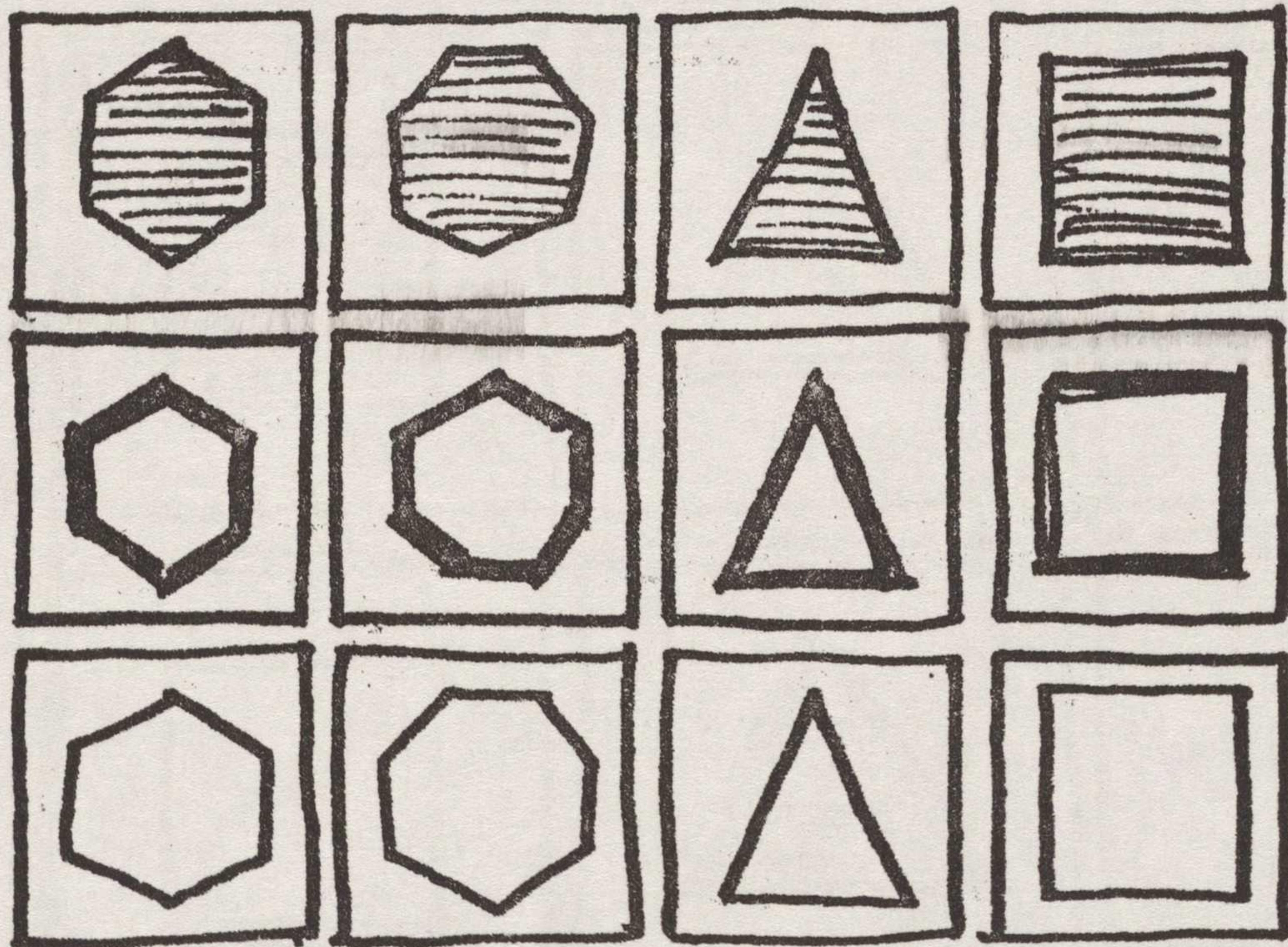
CONTROL OF ERROR

Visual.

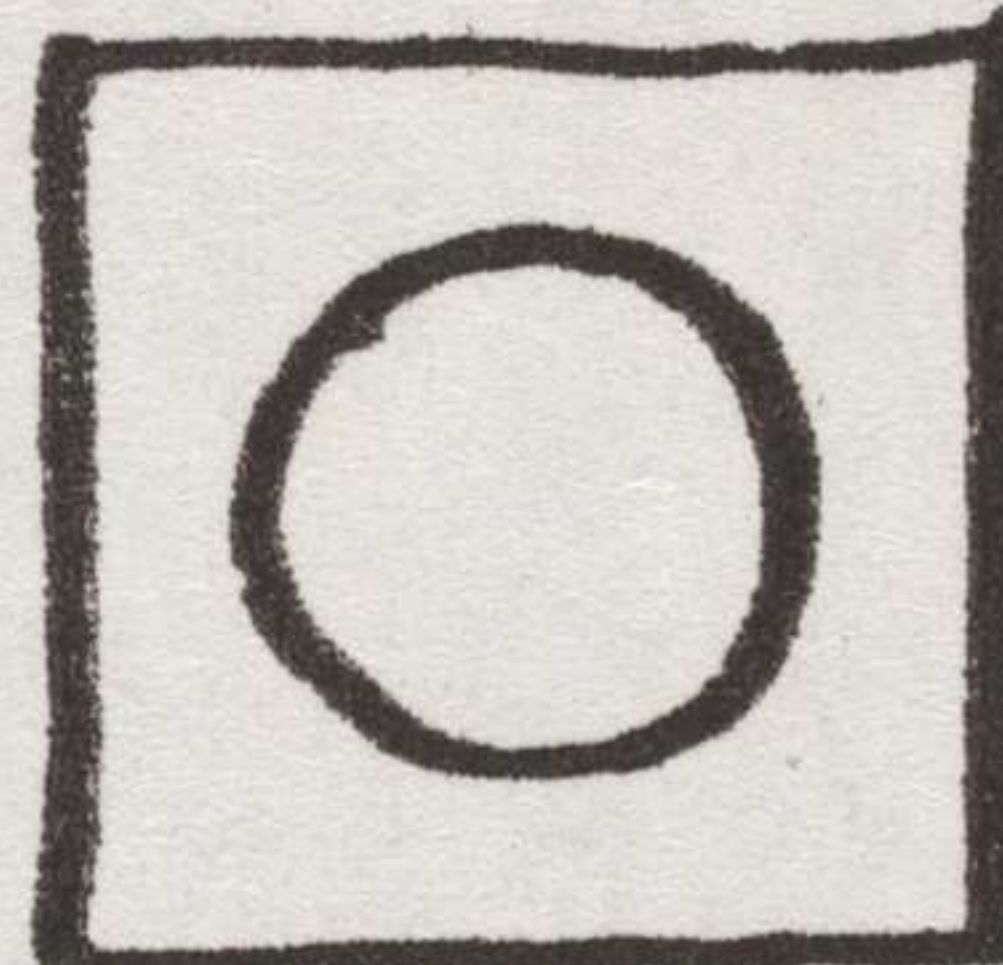
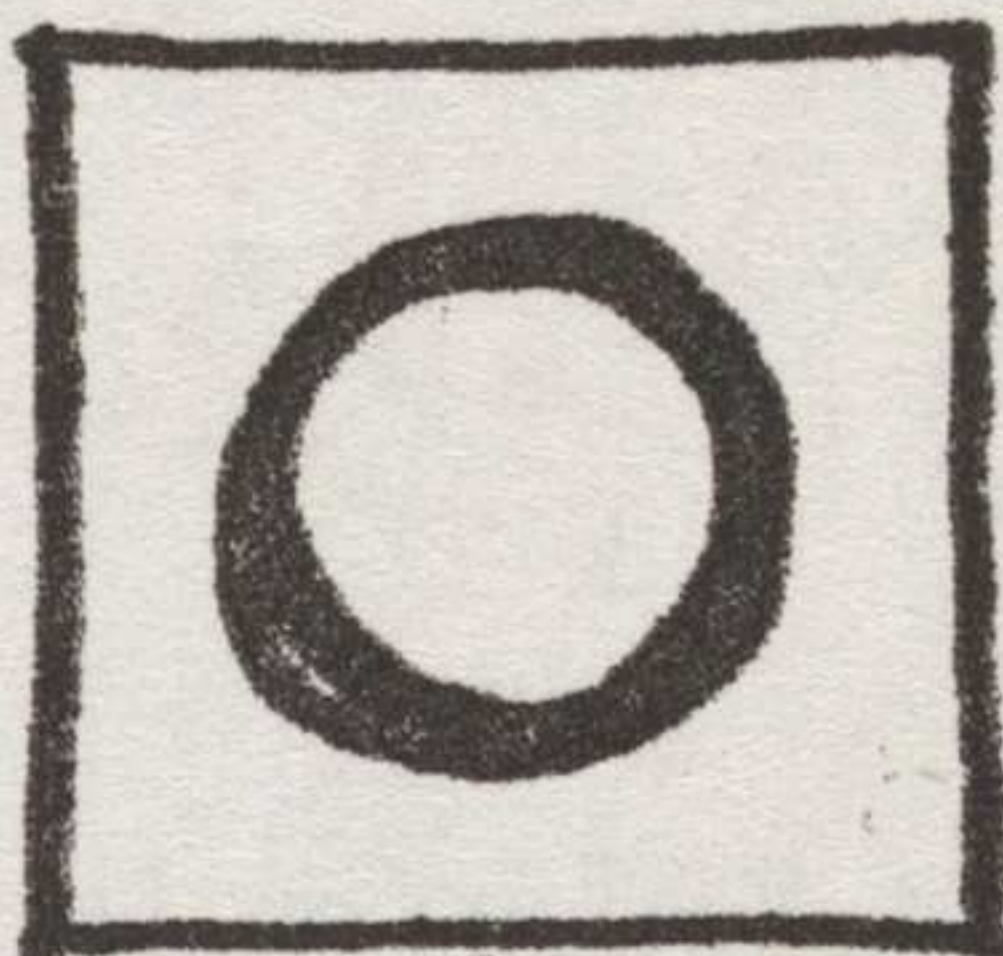


Box III

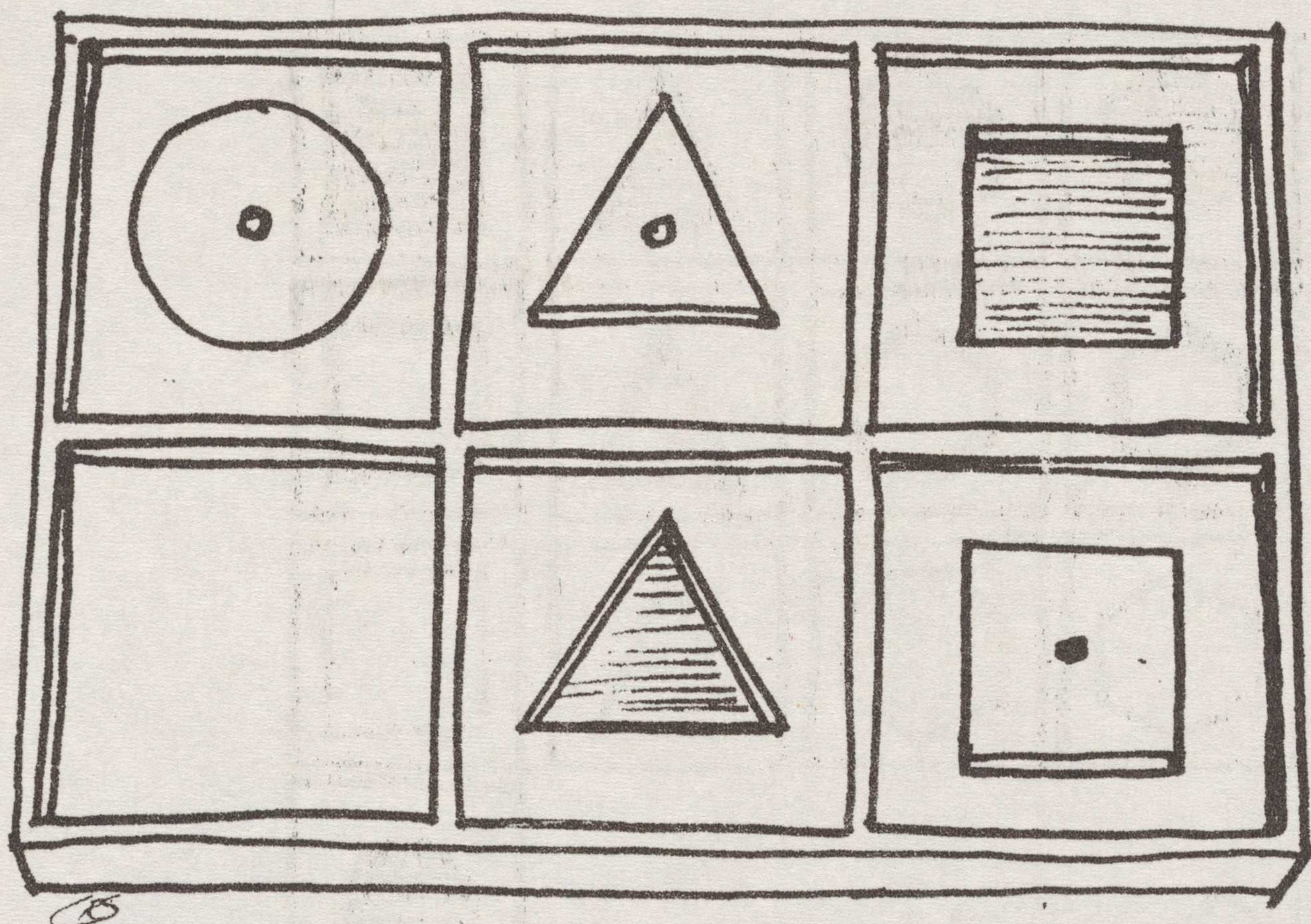




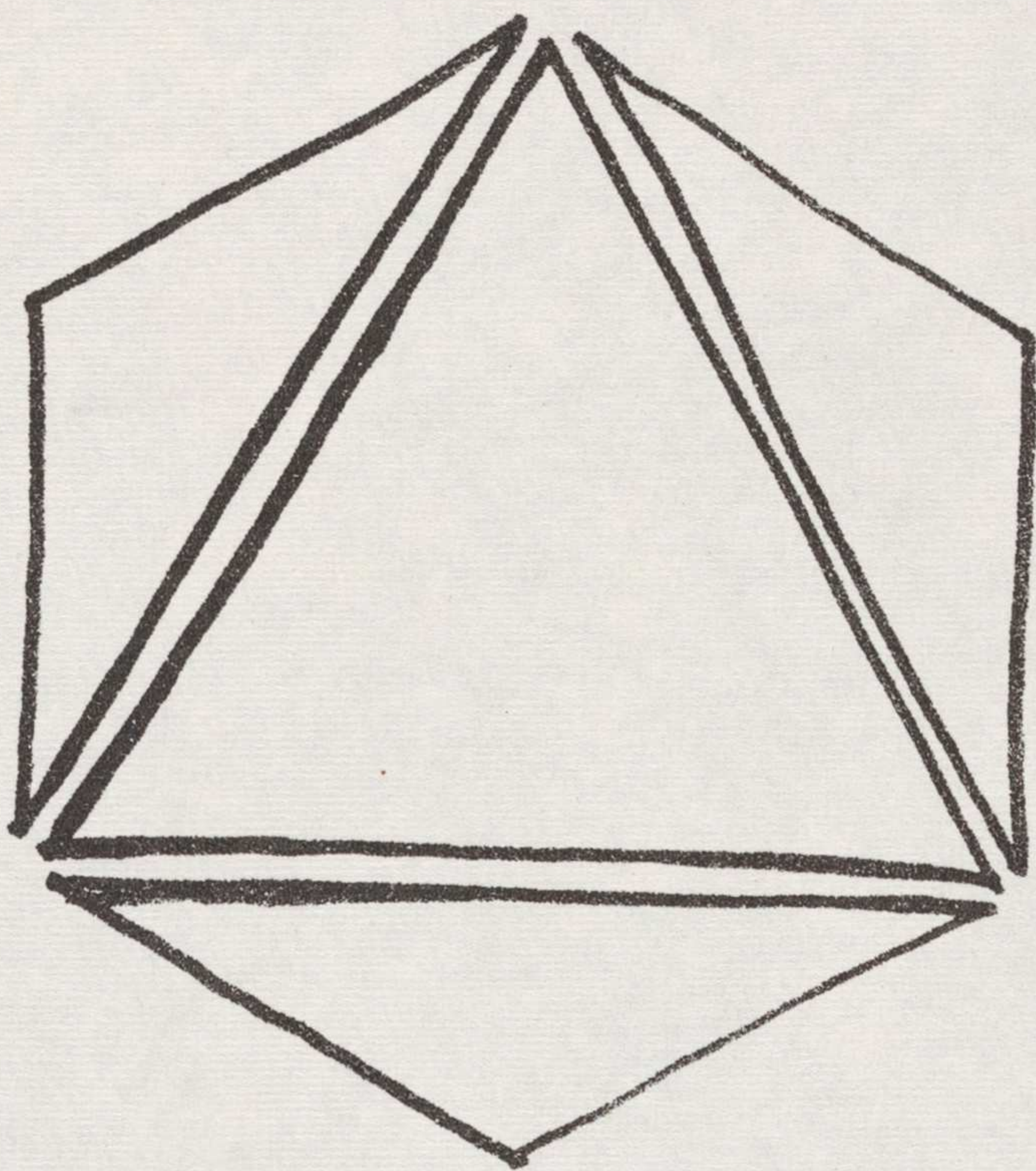
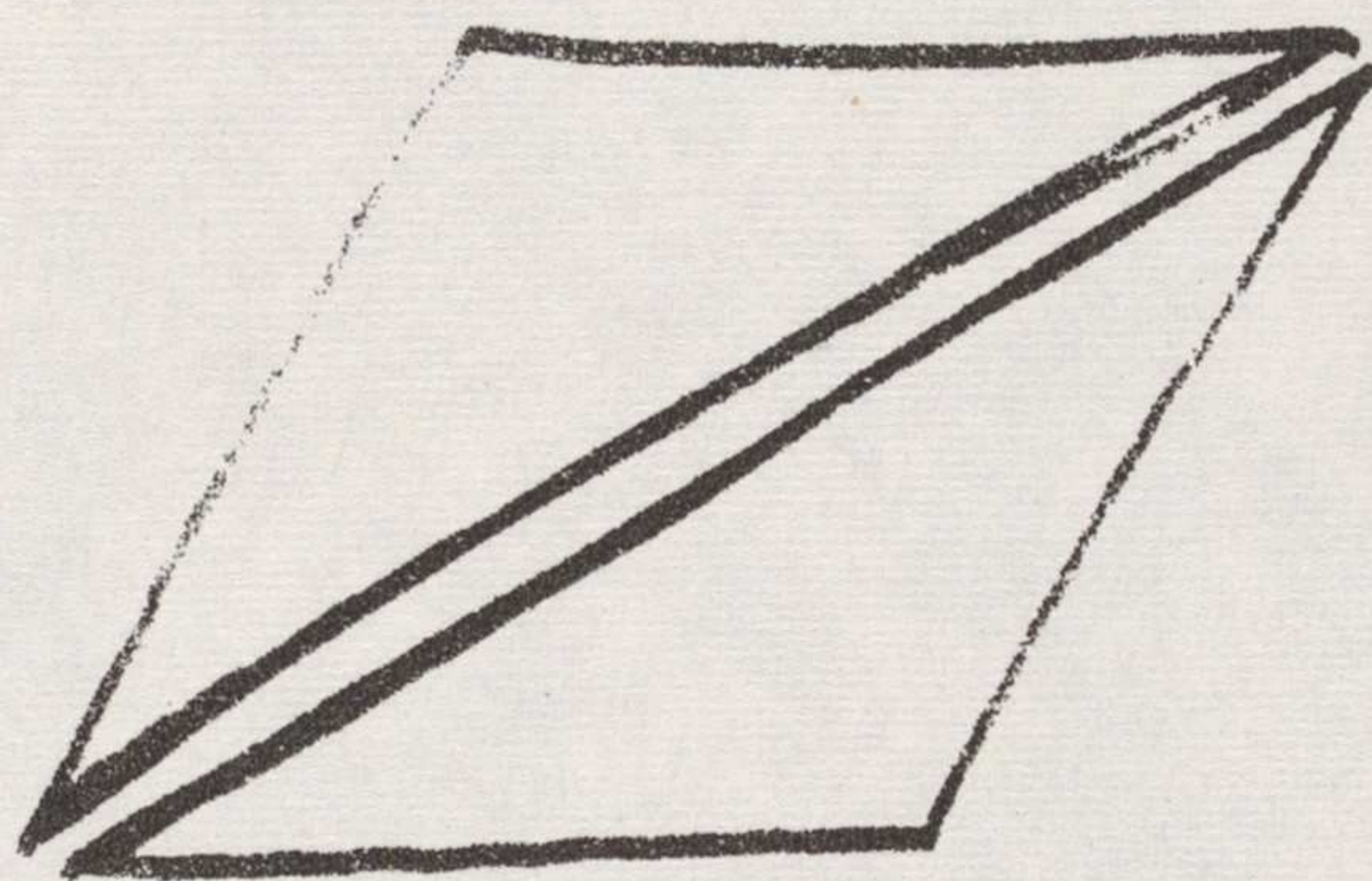
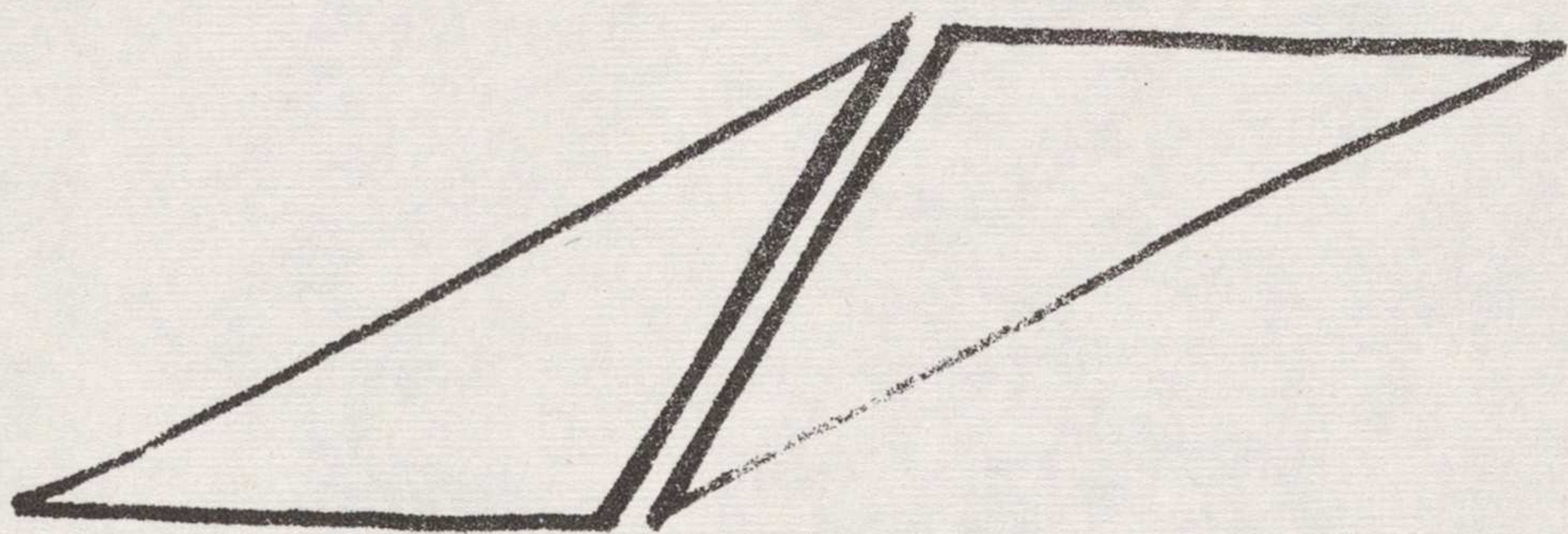
*Geometric
Cabinet Cards*



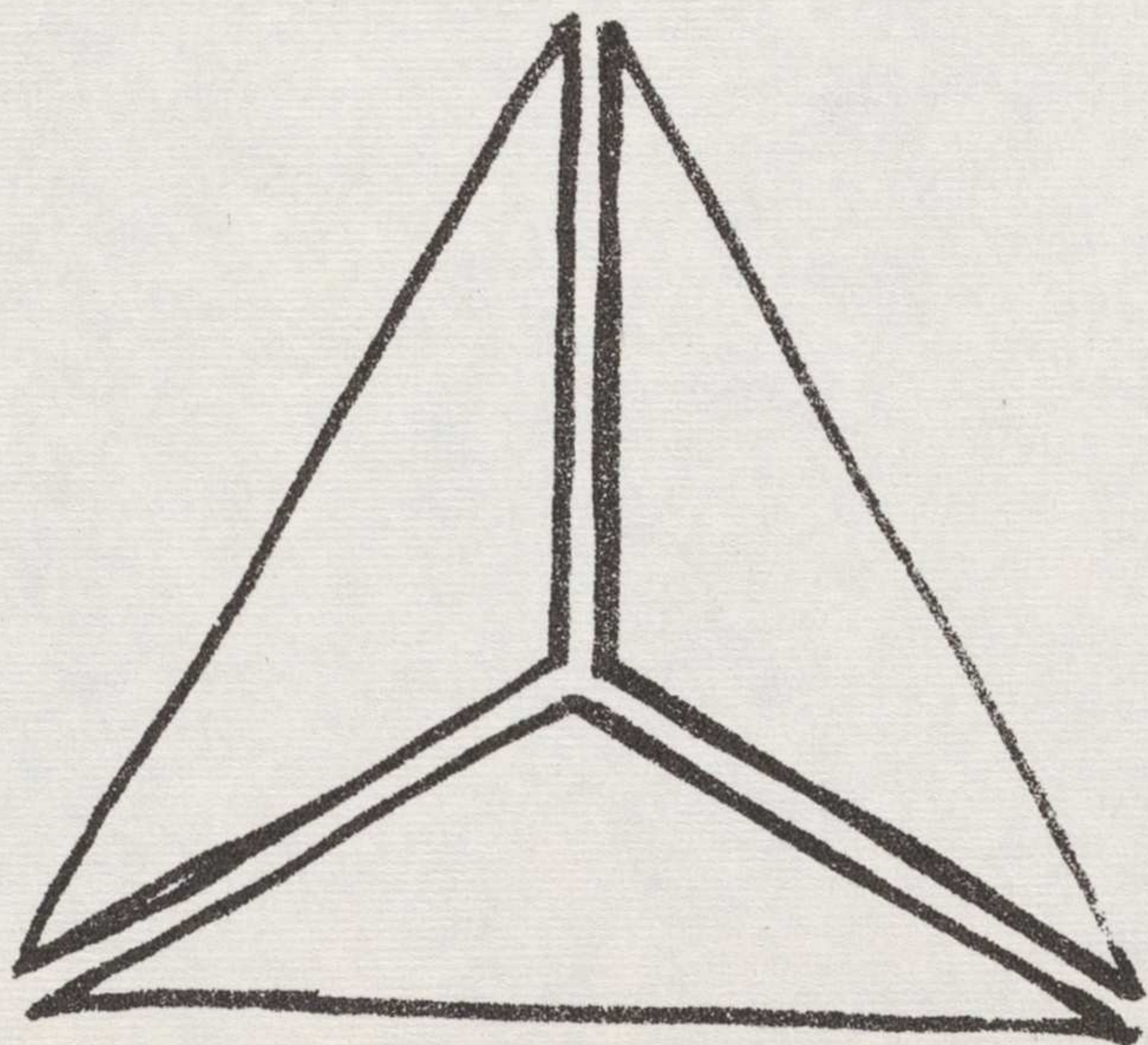
6



Geometric Cabinet
Demonstration Tray



Box IV



THE SYSTEM OF NUMERATION

by

Nancy McCormick Rambusch

THE SYSTEM OF NUMERATION AS IT RELATES TO EARLY LEARNING EXPERIENCES

One of the goals of American elementary education is the mastery of the system of numeration used in the United States, the decimal place additive system. The young child will not discover by himself the rationale of this system which is man-made. The complexity of the system derives from the use it makes of ten as a base position to determine value, of addition in the final expression the numeral, and in the function served by zero, a later addition to the system. Yet, without an understanding of the numeration system, the American child is severely handicapped in his grasp of arithmetic principles and practices. To prepare a child in kindergarten and first grade for an understanding of the decimal place additive system, a teacher needs to understand it herself.

It has become something of a cliché to speak of first graders' need for "meaningful experiences" and a "rich environment," yet these are necessary, though not to the exclusion of a logically structured Arithmetic program. Many teachers of the young are unaware that the understanding of arithmetic principles does not follow automatically from the often random, disorganized experiences of the child's pre-school environment. Teachers must "at all times recognize that Arithmetic is a logical structure as well as a social instrument."¹ The importance of experience in early elementary learning does not preclude an ordered approach to what is to be learned. "Concept development requires that children have time and opportunity for self-directed exploration and discovery The first step in the systematic teaching of arithmetic is to help children discover certain specified mathematical situations in their experiences"² Grossnickle and Brueckner emphasize

that "the core of the (Arithmetic) program for the lower elementary grades should consist of planned systematic and sequential learning experiences. The information which a child brings to school about number and its uses in daily life is disorganized and unsystematized and may have little meaning for the child."³

The lower elementary school child must understand the base ten number system in order to write numbers correctly; he must know the "how many-ness" of the number by recognizing the size of a group (or set); he must be able through counting, to map the ordered set of counting numbers onto the objects of the set he is enumerating.

In an apparently simple procedure of counting, such as figuring on a Wednesday, the number of days left in the week, by calling out the names of the days and for each day called, turning down a finger on the right hand, three important mathematical notions are implicit: The idea of mapping, the idea of one to one correspondence and the idea of cardinal number. "Counting is the first operation learned in elementary arithmetic. Hence, it is usually considered as the beginning of arithmetic. It is true that counting is fundamental to the learning and understanding of all the mathematics that follows, but it is not so well understood that there are more primary concept upon which counting is based. They are sets, mapping, cardinal number and order."⁴

The role of sets in understanding the number system is a recently emphasized one. Children can readily understand the notion of set as a group

or collection of objects, considered as a whole. When a child is faced with an element or object, he knows whether or not it belongs to the particular set. Even young children have experience of this notion, "These are my dolls" "Yours are over there." In being given a fistful of pennies, and then a nickel, a child might reject the nickel because it "doesn't go" with the other coins, in his opinion.

The notion of mapping in its one-to-one reversible form (that it, only one object for only one other object) can be introduced to young children in a variety of school situations. In distributing juice cups, a child might be invited to distribute "as many cups as there are children." He will then usually match cup to child, without counting, saying "One for you" and "one for you" until he has exhausted the supply of children if not of cups. (Later, he might count the number of children first and then the number of cups. When he had finished distributing cups to children, he would know whether or not he had mapped the set of cups onto the set of children properly, by learning whether he came out "even" or had too many children or cups.) The common property abstracted from the process of mapping is the "manyness" of the elements of each set in relation to the elements of another set.

It is not always necessary to count to be able to see that in a given set there are a certain number of elements (Three, for example). (The eye can apprehend sets of small size without counting; hence children need not know how to count in order to understand the notion of the set. Without

yet counting, a child can learn the symbol "3", which indicates the size of the set. Through the practice of mapping it is possible to arrange sets in an ordered fashion. A proper sub set contains some, but not all, the elements of a given set. The number of this sub set is "less than" the number of the given set. "If a set can be mapped in a one-to-one correspondence to a proper subset of another set, we say that the number of the first set is less than the number of the other set."⁵ Through mapping, we arrive at an ordered set of numbers. Symbolically expressed, these numbers constitute an ordered set of numerals. This set of numbers is called counting numbers-- $N=(1,2,3,4,5,\dots,n\dots)$.

Children see that there are ways to express the size of sets symbolically with pebbles, tongue depressors, tally marks, etc. Without embarking on too detailed an historical survey of primitive techniques of numeration, the teacher can recapitulate history by inviting the children to indicate the number of the set through these materials.

"Numeration is the study of how symbols are written to represent numbers."⁶ An example might be cited of a rancher who counting his sheep, compares a single sheep with the name "one", and two sheep with the names "one" and "two", etc. Man now has two common symbols for number, the numeral and the name. The impact of the decimal system of numeration is felt by the young child attempting to count above nine. Though the numbers which can be represented by the decimal system are limitless, the rationale

of place value must be understood, if the digits in a numeral are to reflect correctly the size of the number.

Though a number system and a numeration system are different entities, the numeration system follows from the number system. Croze states that the diversity of modes of representation of natural numbers leads to two distinct studies: Arithmetic and Numeration. He defines Arithmetic as the science which deals with the set of natural numbers; it is the study of their properties, independently of the way in which they are represented. Numeration is the art of symbolically representing natural numbers. Numeration must take into consideration the fundamental properties of Arithmetic (therefore a study of it is deferred to the end of the book, Arithmetique)⁷. Having established the distinction between the number system and the numeration system, one sees that to be adequately representative, a numeration system must include a group of numerals and a set of rules which allow for the notation of any natural number. Our decimal place additive system with a base of 10 (decem - Latin ten) uses the set of counting numbers and zero. The conventional way of writing numbers implies the notion of place value. The individual characters we use in writing a number as a numeral we call digits. "For natural numbers, the digit in the rightmost position of the numeral indicates units and is called the one or units digit. Moving toward the left, the second digit of a numeral indicates how many tens are contained in the number indicated by the numeral. This is called the tens digit. Similarly, the next digit to the

left is the hundreds digit, the next the thousands, etc...."⁸ Each place represents the value of ten times the place to its right, or $1/10$ the value of the place to its left.

How do we relate number to its name? As we count, we set up a one to one correspondance between the objects we are counting and sets of spoken number names. When the count ends, the last number named is the number indicating the size of the set.

What, if any, are the advantages of our system of numeration? Apparently, Arabic numerals proved more convenient than Roman and Hebrew ones, because they offered the possibility of writing an indefinite quantity of numbers with very few symbols (called digits). This paucity of digits is only possible because of the fact that its place or position in the numeral determines its size. Thus, four hundred twenty eight can be written 428, each digit in the numeral deriving its value from its position. A dramatic way to show children the role of place value is to super impose on a card of

4	0	0
---	---	---

 another card of

2	0
---	---

, then a card on which is

8

. In this way the role of place become apparant

4	2	8
---	---	---

.

To express a numeral in which there are six tens and no units would pose a problem in our number system, had not the Arabs introduced the symbol 0 to indicate the absence of units. If there were no symbol in the units place, it would be easy to confuse six tens with six units. Zero became a new number in the natural number system and was added to the

counting numbers in the numeration system, to hold the place of a number representing none. In order that zero be incorporated in the natural number system, it had to do so without disturbing the system as it had previously existed. Rules for computation with zero were developed: zero plus any number equals that number and zero times any number gives zero. (This first rule, $0 + x = x$, is called the identity element) Zero has other functions in Arithmetic. It can represent a point on a line, take its place as a symbol for an empty set. Too limited a notion of zero as only "nothing" or "none" may inhibit a child's later understanding of this whole number.

One use of number names or numerals to indicate the number properties of sets is called a cardinal one. An ordinal use of numbers "indicates the position of an element in a series by giving its sequential order".⁹ Cardinal numbers answer the question "How many?"; Ordinal numbers, "Which one?"

In order to ensure familiarity and facility with the notation of our numeration system, practice is necessary. Awareness of place value eliminates many careless computational errors. It is the teacher's responsibility to ensure this competence. "Children will recognize some of these needs in their own daily experience, but other needs must be shown the pupils through experience supplied by the teacher. In this connection, it is well to note that in his experience alone a child

will never meet all number situations called for in later life, nor can he from a large number of isolated arithmetic situations ever come to have a basic knowledge for use in later life. Accordingly, we must teach the pupil a structure of arithmetic and sufficient applications of the structure, so that in new situations, in life problems, he can use the structure for the necessary solution of problems...¹⁰

There are many opportunities in a classroom to communicate nature and functions of numerals. Buying and selling in a classroom store with prices marked on items, weighing and measuring the children in class, cooking which involves following recipes, taking field trips, collecting milk and juice money, keeping the calendar up to date, checking attendance, temperature, etc. Utilizing opportunities to invest experiences with mathematical meaning requires a teacher alert to the principles of arithmetic. If a child remarks that, on a given day, there are thirteen boys present in the class and ten girls, an alert teacher might invite the child to compare these numbers, through the manipulation of a linear counting material (such as a series of rods, a decimeter a section in length). In so doing, the child would map the set of the girls represented by its equivalent rod to the set of boys and discover which group was "less than" the other and came before it in counting.

Young children speak more than they read. The kinds of learning best suited to them at the beginning of the year would involve them in

manipulation of concrete materials. One of the best materials for illustrating the structure and function of the number system is the "numbers pocket". The "numbers pocket" is a device, much like a wall chart, divided into sections, the rightmost representing units, the next tens, the next hundreds. Into the pockets provided in each section, the children place as many discrete objects (long slips of paper, tongue depressors, etc.) as the number requires, for its symbolic expression as a numeral, discovering that each time there are more than nine elements in any one place, each ten elements must be exchanged for one element in the succeeding place. Hence, if a child counts to "twenty two ones", the twenty becomes two groups of ten and the number left to be expressed in the units place is two. In the initial use of the numbers pocket the children bundle up each group of ten and place it in the appropriate place. Later, as a further step to abstraction, they replace each ten units by a single object to indicate one ten. With enough practice in the first grade, children should be able to master the numbers and their numerals to 100 and be able to deal with them in the conventional written notation.

Learning the numbers to one hundred involves other difficulties. We name our numbers peculiarly in English and names such as "eleven, twelve, and thirteen" need to be explained. They do not appear logical to the first grader, who might do as other peoples do and call eleven "ten and one" or "one teen". If we call two tens twenty, why don't we call three tens "threety"? When a child in first grade recognizes place value in a number

such as 56, he may well call it "five ten six", which is correct if not conventional. Teachers must bear in mind that in arithmetic language we use many short cuts which the child will not use if he is encouraged to discover the intermediate steps. Though the first grader cannot discover many aspects of the number system without help, the teacher can dispose him to discovery by ensuring that he understands clearly the principles of the system.

The importance of introducing addition with exchange prior to addition without exchange illustrates the functional value of discovering the meaning of the base ten. If the child attempts to add 48 to 97, he sees immediately that the sum of the units exceeds ten, as does the sum of the tens. He might restate the problem as $(40 + 90) + (8 + 7)$, regrouping according to the associative law of addition: $a + (b + c) = (a + b) + c$, but he still hasn't completely solved the difficulty. $40 + 90$ equals 130 or thirteen tens. $8 + 7$ equals 15 or one ten and five units. All he may express in the units column are units less than the number base, so all he may have is five units. What happens to his one ten? He may add it to the thirteen tens he already has (and he does). But in the tens place, he may not express more tens than the number base, so the group of ten tens must be exchanged for one hundred. What remains in the tens place is four. The addition then can be stated as:

48 = 40 Tens
8 units

48 + 97 =

40
8 units

$$48 + 97 = (40 + 90) + (8 + 7)$$

$$40 + 90 = 130 \quad 130 \quad 100 + 30$$

$$8 + 7 = 15 \quad 15 \quad 10 + 5$$

$$100 + 30 + 10 + 5 = 100 + (30 + 10) + 5 =$$

$$100 + 50 + 5 = 155$$

$$\text{Hence: } 48 + 97 = 155$$

$$\begin{array}{r} \text{Likewise: } 48 \\ + 97 \\ \hline 145 \end{array}$$

The techniques of discovery which Bruner says favor "the well prepared mind" insure real understanding of the principles of Arithmetic, not merely mechanical computation. The conventional statement of the above addition problem becomes for the child a point of arrival, not merely a point of departure. "If concepts and generalizations are to be developed, it is necessary that mathematical thinking be encouraged at all levels of development. Children think mathematically as they are helped to see the mathematics in their experiences. They think when they see mathematical relationships, when they discover relationships of their own, when they try out relationships discovered by others . . ."¹¹

(N.M.C.R.)

Footnotes

1. Fehr, Howard F., "A Philosophy of Arithmetic Instruction" in De Vault, M. Vere, (ed.), Improving Mathematics Instruction, Charles E. Merrill, Columbus, Ohio, 1961, p. 77
2. Clark, John R., and Eads, Laura K., Guiding Arithmetic Learning, World Book Company, Yonkers on Hudson, New York, 1934, p. 6
3. Grossnickle, F. E., and Brueckner, L., Discovering Meanings in Arithmetic, Winston Company, Philadelphia, 1959, p. 19
4. Fehr, Howard F., "What is Counting?" in The Packet, Vol. 17, No. 1, Spring, 1962, D. C. Heath, Boston, p. 3
5. Ibid., p. 7
6. School Mathematics Study Group, Studies in Mathematics, Vol. VI, Number Systems, Yale University, New Haven, Connecticut, no page nos. given.
7. Crozes, Y., Arithmetique, Masson et Cie., Paris, 1956, pp. 9-10
8. Osborn, R., et al., Extending Mathematics Understanding, Charles E. Merrill, Columbus, Ohio, 1961, p. 15
9. Hollister, G. E., and Gunderson, A. G., Teaching Arithmetic in Grades I and II, D. C. Heath, Boston, 1954, p. 10
10. Fehr, Howard F., Improving Mathematics Instruction, p. 77
11. Clark and Eads, op. cit., p. 22

EXERCISES WITH NUMBERS

BY

RUTH WOOD OBOLENSKY

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EXERCISES WITH NUMBERSINTRODUCTION TO NUMBERS

1. Number Rods
2. Sandpaper Numerals
3. Number Rods And Numeral Cards
4. Spindle Boxes
5. Counter Exercise

THE DECIMAL SYSTEM
AND OPERATIONS

1. Introduction To The Decimal System Using Beads
2. Introduction To The Decimal System Using Numeral Cards
3. Introduction To The Decimal System Using Beads And Numeral Cards
4. Decimal System Exercise - Addition
5. Decimal System Exercise - Subtraction
6. Decimal System Exercise - Multiplication
7. Decimal System Exercise - Division
8. Stamp Games

TEENS, TENS AND COUNTING

1. Teens With Beads
2. Teens With Boards
3. Teens With Beads And Boards
4. Tens With Beads And Boards
5. Chain of 100
6. Chain of 1000
7. Bead Chains Of Varying Length

TABLES

1. Bead Snake
2. Strip Board - Addition
3. Charts - Addition
4. Negative Bead Snake
5. Strip Board - Subtraction
6. Charts - Subtraction
7. Multiplication With Bead Board
8. Multiplication Board
9. Charts - Multiplication
10. Division Board
11. Charts - Division

SUMMARY EXERCISES

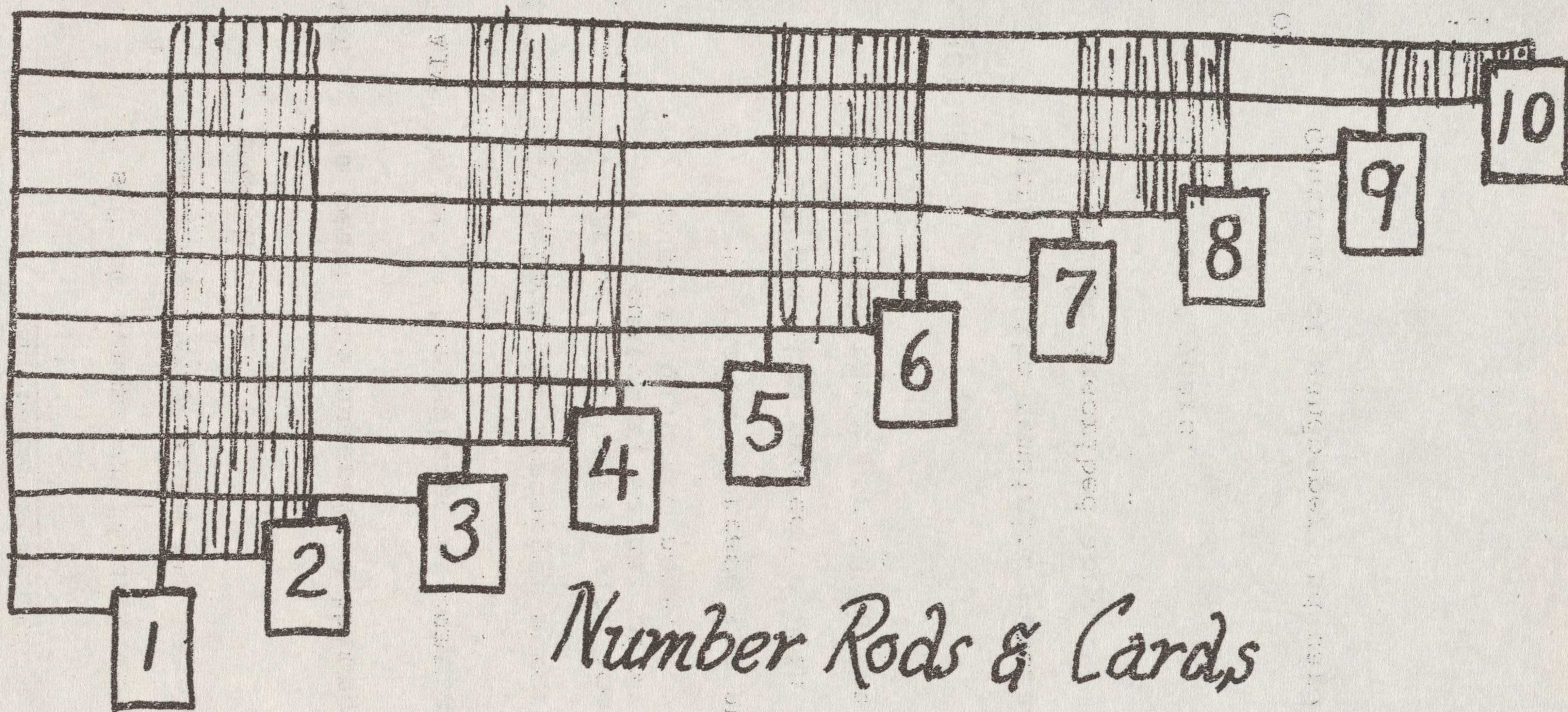
1. Bead Frames
2. Division With Beads And Boards

NUMBER RODS

MATERIAL	Ten painted wooden rods that differ in length. The shortest rod is 10 cm long with each succeeding rod differing from the preceding rod by this length. Each rod is subdivided into 10 cm segments that alternate in color in red and blue.
DIRECT AIM	1. To teach the names of the numbers 1 through 10; that each number represents a quantity of objects; and that there is a proper sequence to the numbers. 2. To introduce the arithmetical operations of "addition" and its inverse. 3. To introduce the arithmetical terms of "greater than", "less than" and "equal to".
INDIRECT AIM	To develop mathematical understanding.
PRESENTATION	1. Build a stair like structure beginning with the unit rod. 2. Select the unit rod, and the rod with two segments. Teach the numbers "one" and "two" with this material by means of the three period lesson.
LATER EXERCISES	1. Gradually introduce the other rods until the supply is exhausted. 2. Demonstrate the operations of "sum" and "difference". 3. Demonstrate the terms "greater than", "less than", and "equal to".
AGE	3-1/2 to 4 years.
CONTROL OF ERROR	The teacher.

SANDPAPER NUMERALS

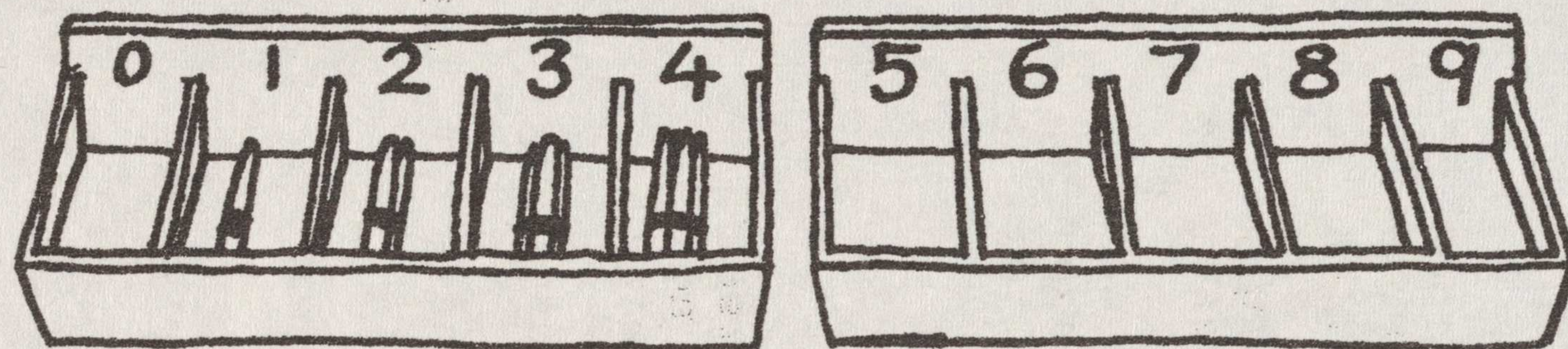
MATERIAL	A set of sandpaper figures cut out in the form of the numerals "0" through "9", each mounted on a separate smooth card.
DIRECT AIM	To teach the numerals 0 through 9.
INDIRECT AIM	To teach the writing of numerals.
PRESENTATION	1. Select the sandpaper numerals "1" and "2". 2. Trace one numeral with index and middle fingers in the customary manner of writing. While tracing the numeral give the name. 3. Have the child trace the numeral and give its name. 4. Repeat the procedure with the other numeral. 5. Finish their period naming lesson.
LATER EXERCISES	Introduce the remaining numerals in random order and in the method described above.
AGE	3-1/2 to 4 years.
CONTROL OF ERROR	Contrast of sandpaper and card surfaces.



Number Rods & Cards

NUMBER RODS AND NUMERAL CARDS

- MATERIAL** Number Rods and a set of nine cards each marked with a numeral 1 through 9.
- DIRECT AIM** 1. To associate numbers 1 - 9 with the numerals 1 - 9.
 2. To teach numerical sequence.
- INDIRECT AIM** Preparation for mathematical understanding.
- PRESENTATION** 1. Place all rods on a rug in mixed order.
 2. Place all numeral cards on the rug in mixed order.
 3. Select a numeral card and ask the child to hand you the corresponding rod. Place the card upright against one end of the rod.
 4. Continue matching rod with card until all cards are employed.
- LATER EXERCISES** 1. Select a number rod and ask the child to find the corresponding numeral card. Place the card against one end of the rod.
 2. Continue matching card with rod until all cards are exhausted.
 3. Build a stairlike pattern from the rods placing each numeral card against the end of the appropriate rod. The numeral cards are then in sequential order.
- AGE** 4 years.
- CONTROL OF ERROR** The teacher.

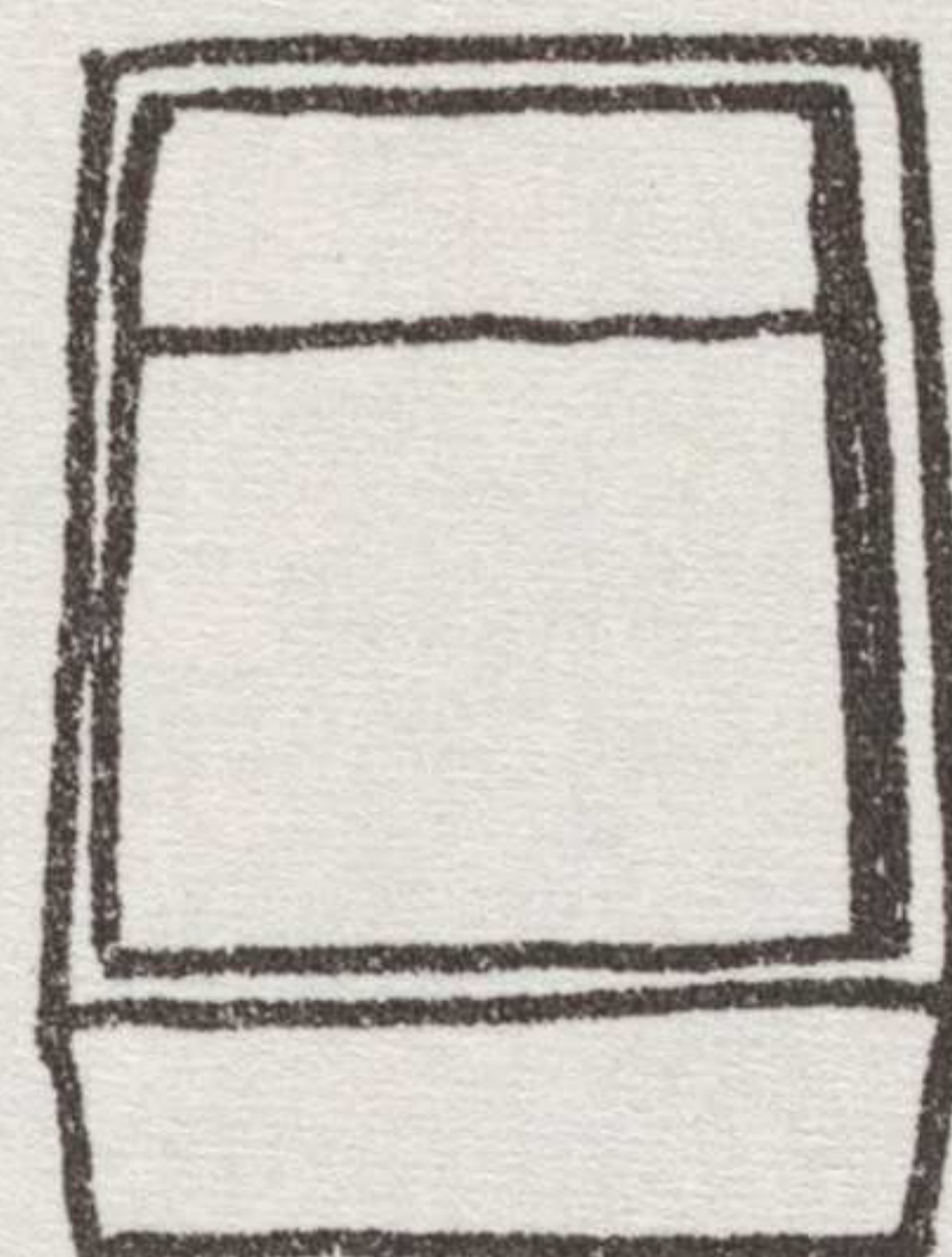


Spindle Boxes

SPINDLE BOXES

MATERIAL	Two polished wooden boxes, each with five compartments. The compartments are marked sequentially by the numerals 0 through 9. A basket containing 45 wooden spindles and 9 rubber bands.
DIRECT AIM	To introduce the numeral zero and its meaning. To show that numerals symbolize quantities of separate objects.
INDIRECT AIM	To develop mathematical understanding.
PRESENTATION	1. Enunciate the numeral "one" that marks the second compartment, and put one spindle with a rubber band around it into it. 2. Enunciate the numeral "2" that marks the third compartment. Select two spindles, place a rubber band around them and put the two spindles as a unit into this compartment. 3. Continue in this manner until the exercise is completed. 4. Draw the child's attention to the fact that the compartment marked by 0 remains empty.
LATER EXERCISES	Note: This exercise is done with a group of children. Ask one child to bring you seven pencils, another two cubes, a third zero rods, and so on.
AGE	3-1/2 to 4 years.
CONTROL OF ERROR	The teacher.

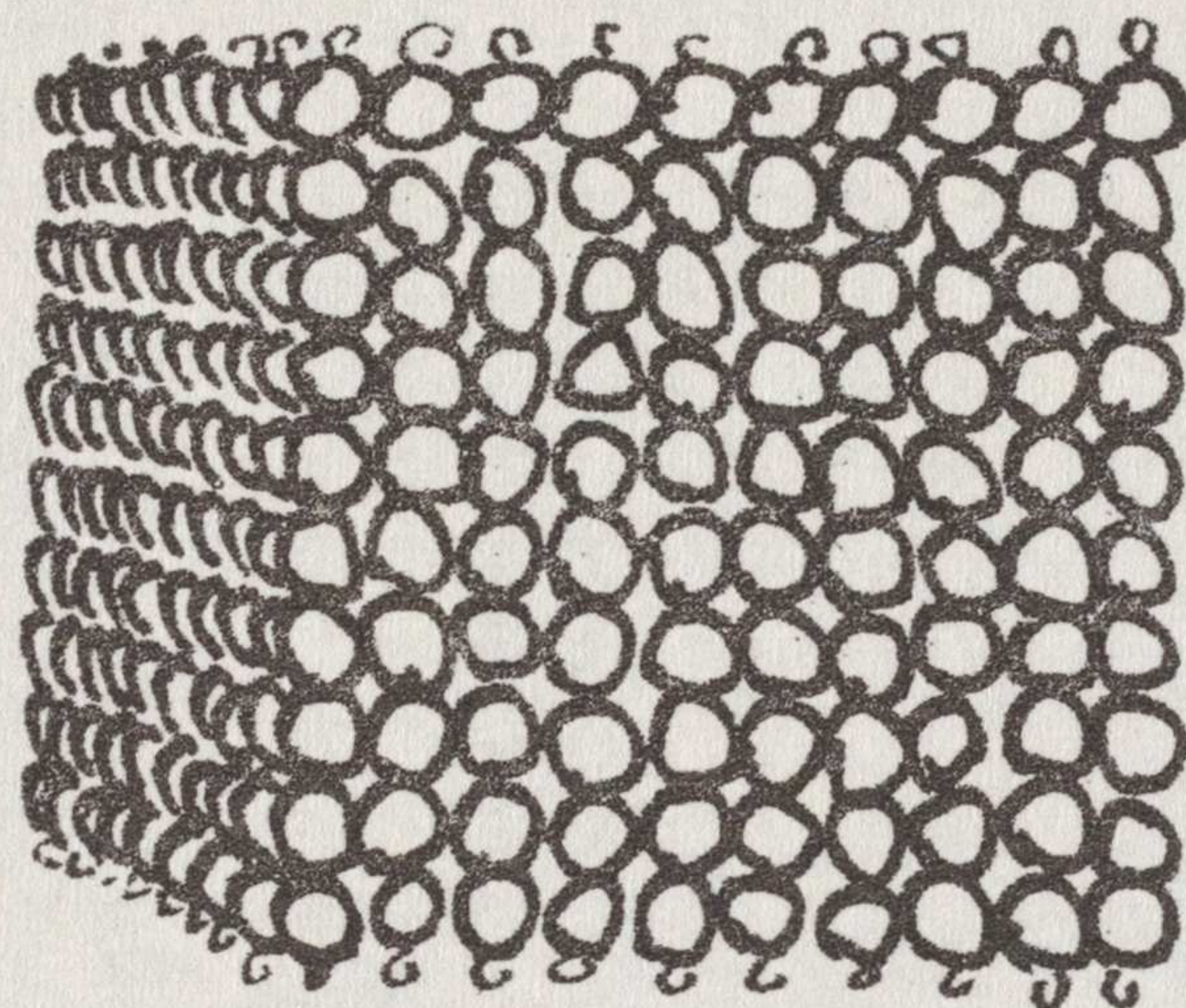
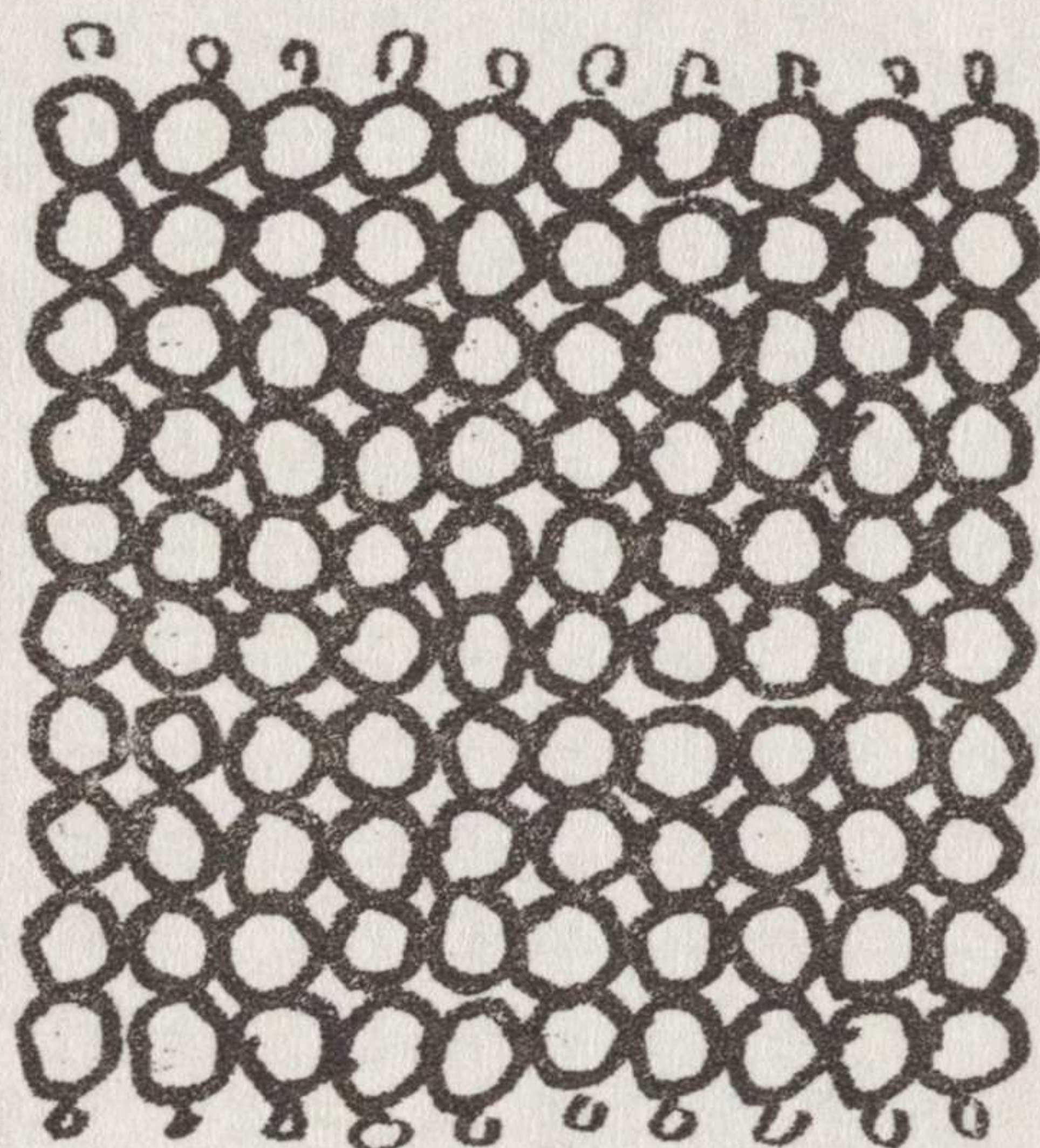
1	°	
2	° °	
3	° °	
4	° °	
5	° °	
6	° °	
7	° °	
8	° °	
9	° °	



Counters

COUNTER EXERCISE

MATERIAL	1. A set of numerals 1 through 9 and 45 counters (or chips) in a box. 2. A box that contains a number of folded slips of paper on each of which is written any one of the numerals 0 through 9.
DIRECT AIM	1. To test the child's facility with the ordinal numbers. 2. To test the child's ability to associate the numbers 1 through 9 with the appropriate numerals.
PRESENTATION	1. Ask the child to arrange the mixed numerals in ordinal sequence in a column leaving a small space between any two numerals. 2. Have the child enunciate each numeral in sequence. Then ask him to hand you one counter. Place this counter beside the numeral 1. 3. Ask the child for two counters and place these in a row beside the numeral 2. 4. Ask the child for 3 counters. Arrange the three counters beside the numeral 3 so that the first row will contain 2 counters and the third counter is placed in the second row and first column. 5. Continue in this manner until all counters have been placed.
LATER EXERCISES	Note: This exercise is done with a group of children. 1. Have each child pick a piece of paper from the box, unfold it, read the numeral (silently), refold the piece of paper and place the slip on his table. 2. Ask each child in the group to go and bring back to his table the number of objects indicated by the numeral on his slip. The objects must come from within the room and all children do this exercise simultaneously. 3. Ask each child to read the numeral on his slip of paper and count the objects that he has collected, all under your supervision.
AGE	3-1/2 to 4 years.
CONTROL OF ERROR	The teacher.



Golden Bead Material

INTRODUCTION TO THE DECIMAL SYSTEM
USING BEADS

MATERIAL

1. On a wooden tray: one gold bead, one bar of 10 gold beads, one square of 10 bead bars, and one cube of 10 bead squares.
2. Four wooden trays: ten ^{bead} cubes on one tray, ten bead squares on the second tray, ten bead bars and a bowl of ten beads on the third tray, and the fourth tray empty.

DIRECT AIM

1. To teach names of the following quantities: unit, ten, hundred and thousand.
2. To show relationships between these quantities.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Using the material described in (1) above employ the three period lesson to teach the names "unit" (one) and "ten", then "hundred" and "thousand".
2. Show that one bead-bar is composed of ten unit beads, one bead square of ten bead bars, that one bead cube is composed of ten bead squares.

LATER EXERCISES

1. Using the material described in (2) above, ask a child to bring on the empty tray a certain number of one of the decimal groups, e.g., 9 "hundreds". Verify the quantity.
2. Ask the child to bring varying numbers first of two, then of three, and finally of four decimal groups.

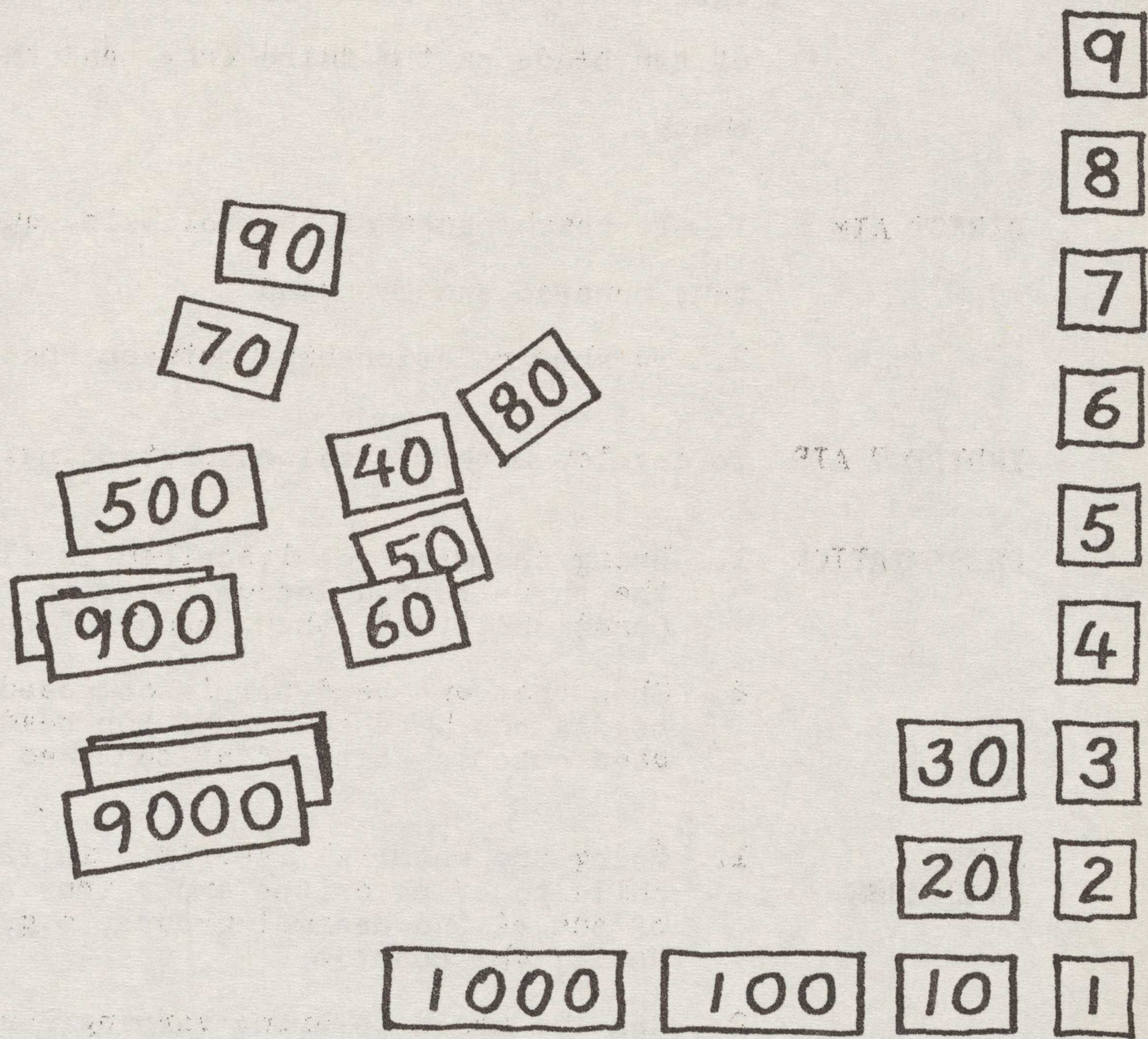
AGE

4 years.

CONTROL OF ERROR

The teacher.

Decimal Cards



INTRODUCTION TO THE DECIMAL SYSTEM

USING NUMERAL CARDS

MATERIAL

1. A box containing four sets of large numeral cards as follows:
 - a) numerals 1 through 9 printed in green.
 - b) two-digit numerals 10, 20, ...90 printed in blue.
 - c) three-digit numerals 100, 200, ...900 printed in red.
 - d) four-digit numerals 1000, 2000, ... printed in green.
 Cards vary in size proportionately to the number of digits in the numeral.
2. One empty tray.

DIRECT AIM

To teach the names of the numerals.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: ensure that the child views the cards from the correct position.

1. Count through the set of unit cards.
2. Take the 10-card and 100-card and teach the names of these numerals using the three period lesson.
3. Count through the set of cards, with the two-digit numerals enunciating "one ten", "two-tens", "three tens", etc. Repeat this procedure with the set of cards that have the three-digit numerals.

LATER EXERCISES

1. In the way of review, repeat the presentation (2) above, then select the 1000-card and teach the name of this numeral.
2. Repeat the presentation of (3) above, enunciating "one thousand", "two thousands", "three thousands", etc.
3. Place the numeral cards on a floor mat so that each set will form a column beginning with the lowest numeral at the top and the highest numeral at the bottom.
4. Ask the child to bring on the tray a specified numeral card.
5. Ask the child to bring on the tray two, then three, then four specified numeral cards.
6. Show the child how the separate numeral cards will combine to form one numeral.

AGE 4 to 4-1/2 years.

CONTROL OF ERROR

The teacher.

INTRODUCTION TO THE DECIMAL SYSTEM

USING BEADS AND NUMERAL CARDS

MATERIAL

Four wooden trays: ten bead cubes on the tray, ten bead squares on the second tray, ten bead bars and a bowl of ten beads on the third tray and one empty tray. A small bowl and one set of large numeral cards.

DIRECT AIM

To associate number with decimal numeral.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Place on the child's tray numeral cards chosen from varying decimal groups.
2. Ask the child to bring the number of beads indicated by the numeral cards. Count to verify.
3. Slide the numeral cards together to form one numeral.
4. Ask the child to read the numeral.

AGE 4-1/2 to 5 years.

CONTROL OF ERROR

The teacher.

DECIMAL SYSTEM EXERCISE - ADDITION

MATERIAL Gold bead material as follows: single beads, bars, and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Three wooden trays one of which is larger than the other three. Four small bowls, one on each tray.

DIRECT AIM To do the operation of addition using large sets.

INDIRECT AIM To develop mathematical understanding.

PRESENTATION Note: This exercise is done with a group of 4 children.

1. Place the three sets of numeral cards on floor mats so that each set will form a column in which the initial digits are arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Select two sets of small numeral cards and place each set on a small tray. Each set will consist of one of the unit cards, one of the "ten" cards and one of the "hundred" cards. The cards must be chosen such that the sum of the unit numerals exceeds 10.
4. Ask each child to bring on his tray the quantity of beads indicated by the numeral cards on his tray. The children will then place their trays on the floor mat in one column, with the numeral cards on the right and the beads on the left side of the trays.
5. Now transfer the bead material from the small trays onto the large tray which will have been placed below the column of the two small trays.
6. Sort the bead material into separate groups of units, bars, and squares.
7. Count the quantity of beads. You will find that there will be more than 10 unit beads. Exchange sets of 10 beads for as many bead bars.
8. Find the combination of large numeral cards that represent the quantity of beads on the tray and place them to the right of the beads.
9. Recapitulate the presentation by telling the children that you have united two quantities to form one large quantity.

LATER EXERCISES

1. Construct exercises that will require the exchange of bars for squares and squares for cubes, as unit beads were exchanged for bars in (7) above.
2. Ask a child to take the place of the teacher.

AGE 4-1/2 to 5 years

CONTROL OF ERROR The teacher.

DECIMAL SYSTEM EXERCISE - SUBTRACTION

MATERIAL

Gold bead material as follows: single beads, bars and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Three wooden trays one of which is larger than the other two. Three small bowls, one for each tray.

DIRECT AIM

To do the operation of subtraction as the inverse of addition.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: this exercise is done with a group of three children.

1. Place the three sets of numeral cards on floor mats so that each set will form a column in which the initial digit is arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Form a three or four digit numeral with large numeral cards and place on the large tray.
4. Ask the child to bring on the large tray the quantity of beads indicated by the numeral. Have him place the beads to the left of the numeral cards.
5. Using the small cards, form a numeral smaller than the first and place it on a small tray. This tray is then placed below the large tray.
6. Explain to the children that the small numeral indicates the number of beads to be separated from the quantity of beads on the large tray. Execute the separation by placing the indicated quantity of beads on the small tray to the left of the cards. During the separation regroup bead cubes into bead squares, squares into bars and bars into single beads, to the extent necessary.
7. Count the quantity of beads that forms the remainder on the large tray. As the remainder is counted it is placed on a second small tray below the other two trays. Then form the numeral in small cards that represents the quantity of beads on the tray. Place the numeral to the right of the beads.
8. Recapitulate the presentation by telling the children that the large quantity has been separated into two quantities.

LATER EXERCISES

1. Ask a child to take the place of the teacher.
2. Show how a difference between two quantities can be found by mapping one quantity onto another.

AGE 4-1/2 to 5 years.

CONTROL OF ERROR The teacher.

DECIMAL SYSTEM EXERCISE - MULTIPLICATION

MATERIAL

Gold bead material as follows: single beads, bars, and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Three wooden trays one of which is larger than the other two. Three small bowls, one on each tray.

DIRECT AIM

To do the operation of multiplication as the union of equal sets.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: This exercise is done with a group of 3 children.

1. Place the four sets of numeral cards on floor mats so that each set will form a column in which the initial digits are arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Select two identical sets of small numeral cards and place each set on a small tray. Emphasize that the sets are identical.
4. Ask each child to bring on his tray the quantity of beads indicated by the numeral cards on his tray. The children will then place their trays on the floor mat in one column, with the numeral cards on the right and the beads on the left side of the trays.
5. Now transfer the bead material from the small trays onto the large tray which will have been placed below the column of the three small trays.
6. Sort the bead material into separate groups of units, bars, and squares.
7. Count the quantity of beads. Make necessary exchanges as in the "addition" exercise.
8. Find the combination of large numeral cards that represent the quantity of beads on the tray and place them to the right of the beads.
9. Recapitulate the presentation by telling the children that you have united two equal quantities to form one larger quantity.

LATER EXERCISE

Ask the child to take the place of the teacher.

AGE 4-1/2 to 5 years

CONTROL OF ERROR
The teacher.

DECIMAL SYSTEM EXERCISE - DIVISION

MATERIAL

Gold bead material as follows: single beads, bars and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Five wooden trays, one large, one of medium size and three small trays. One bowl to each tray.

A basket containing 9 small, green ribbon bows and one large bow in light-blue ribbon.

DIRECT AIM

To do the operation of division.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: this exercise is done with a group of four children.

1. Place the three sets of numeral cards on floor mats so that each set will form a column in which the initial digit is arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Form a four-digit numeral with large cards and place on the large tray.
4. Ask a child to bring on the large tray the quantity of beads indicated by the numeral. Have him place the beads to the left of the numeral cards.
5. Explain to the children that this is the quantity to be separated into three smaller equal quantities. That is to say, that each child will receive the same quantity of beads on his tray. Execute the separation by first distributing the bead cubes. When an equal distribution cannot be made, exchange the remaining cubes for bead squares. Then distribute the squares and, when necessary, exchange the remaining squares for bead bars. Continue this process until the even distribution has been made.
6. Ask each child to count the quantity of beads on his tray and then to find the small numeral cards that will represent this quantity. Have him place the cards to the right of the beads.
7. Ask the children to place their trays side-by-side in a row and below the large tray.
8. If any beads still remain on the large tray, place these beads below the row of small trays. Ask a child to find the small numeral card that represents the remainder.
9. Recapitulate the presentation by telling the children that the large quantity of beads has been divided into three smaller but equal quantities and a remainder.

DECIMAL SYSTEM EXERCISE - DIVISION - CONTINUED

LATER EXERCISES

Note: for part of the following exercise 12 children will be required.

1. Ask a child to take the teacher's place.
2. Present a division exercise where the large quantity of beads is to be divided into 12 equal groups.
 - a) Present the exercise in the same manner as described above except for the following differences:
 - b) Have ten of the children represented by one child who will wear a blue bow. The two children that act on their own behalf will wear a green bow each.
 - c) Divide the quantity of beads as represented by the numeral cards into three parts, by giving the child with the blue bow always 10 times the quantity of beads that either of the other two children receives. In so doing exchange bead cubes for squares, squares for bars and/or bars for single beads at such times when the next distribution would make a 10:1 division not possible. The child who wears the blue bow will use the medium-sized tray.
 - d) When the division has been completed, call the nine children that were represented by the one child and ask them to stand in a group with the child who represented them.
 - e) Recapitulate the exercise by explaining to the children that the large quantity has now been divided into three quantities - two equal and one ten times that of either of the two; - hence, that the original large quantity of beads can be divided into 12 equal quantities by applying the same general procedure in dividing the quantity of beads on the medium-sized tray into ten equal groups.
 - f) Emphasize the quantity of beads in one of the equal groups and the remainder.

AGE 5 - 6-1/2 years.

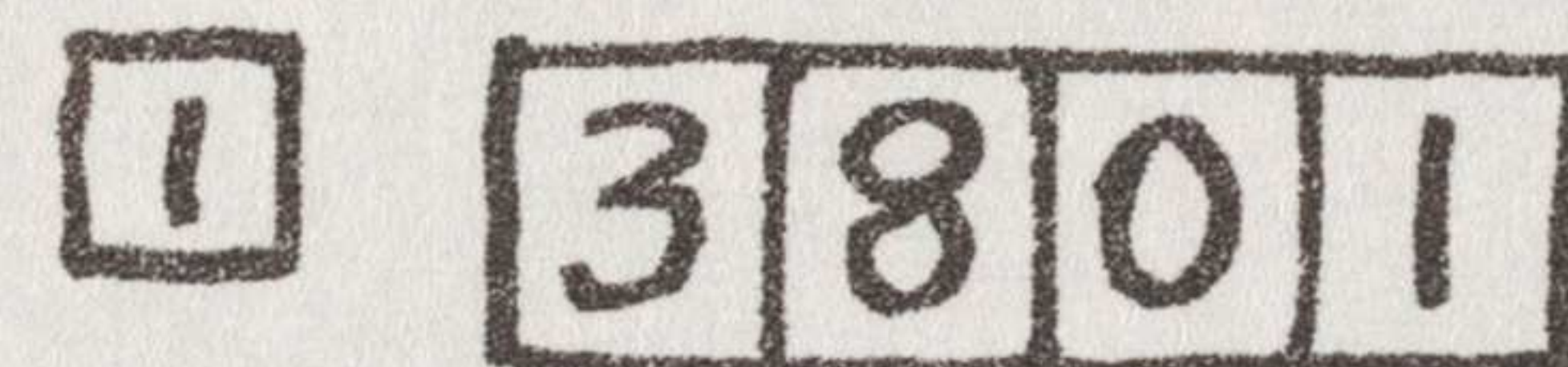
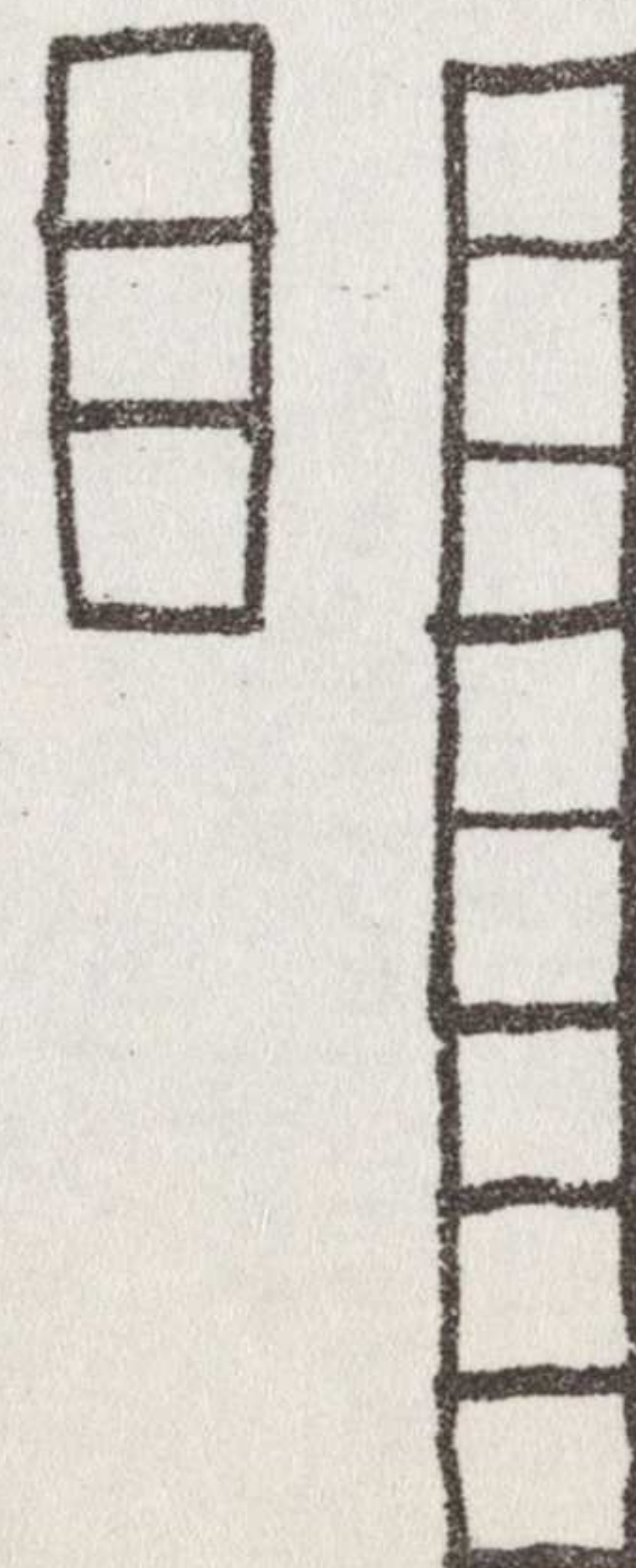
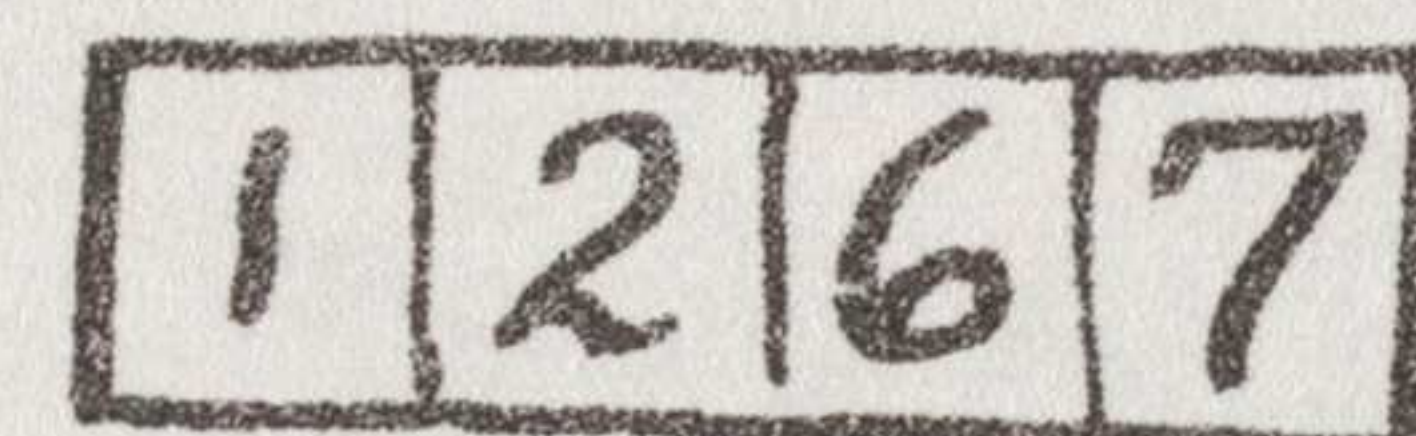
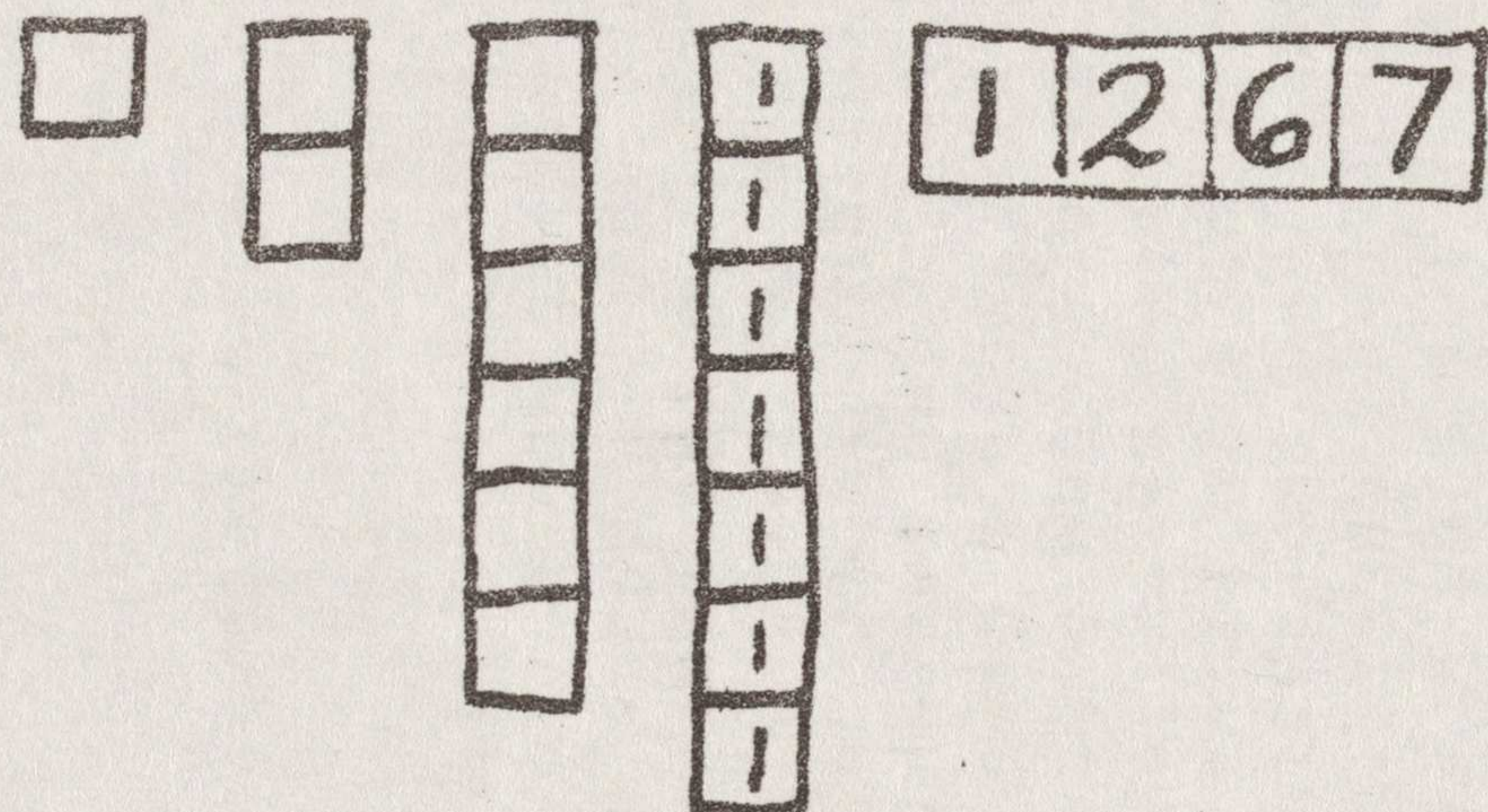
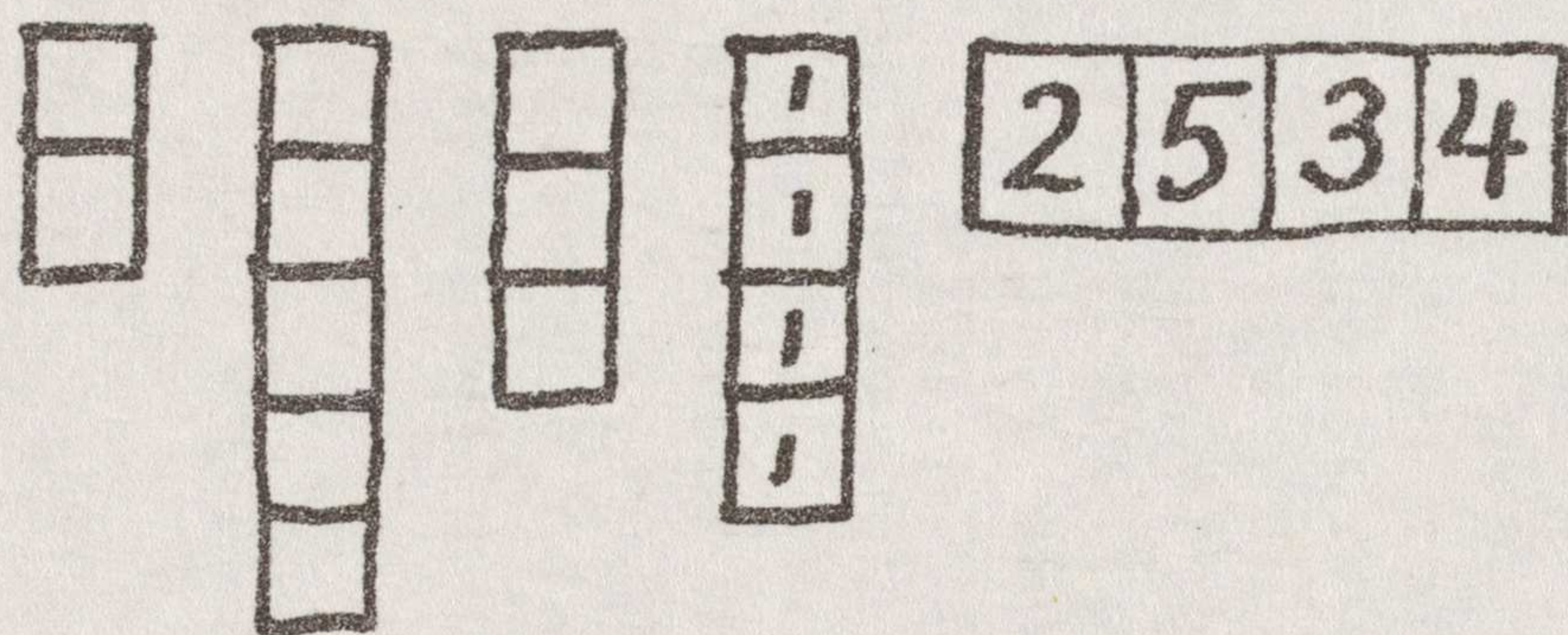
CONTROL OF ERROR

The teacher.

The Stamp Game - Addition

I

II



STAMP GAMES

MATERIAL

A box that is divided into four compartments. Each compartment contains a number of square wooden tablets referred to as stamps hereafter. The stamps differ in color and are marked by different numerals. One set of stamps is colored green and marked with the numeral 1. A second set of stamps, all of which are marked with the numeral 10, are colored blue. The third set of stamps is red and marked with the numeral 100. The fourth set of stamps is marked with 1000 and colored green.

A basket that contains 28 skittles as follows: one large green skittle and three sets of small skittles, 9 in each set, that are colored red, blue and green, respectively. The basket contains also a number of green, blue and red disks.

One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000.

A quantity of blank cards of the same size as the numeral cards.

A container with three colored pencils in green, blue and red and one black pencil.

Four white cards on which are printed the signs that represent the mathematical operations of addition, subtraction, multiplication and division.

A number of sheets of square-ruled paper.

DIRECT AIM

To give the child the opportunity to perform the four mathematical operations independently.

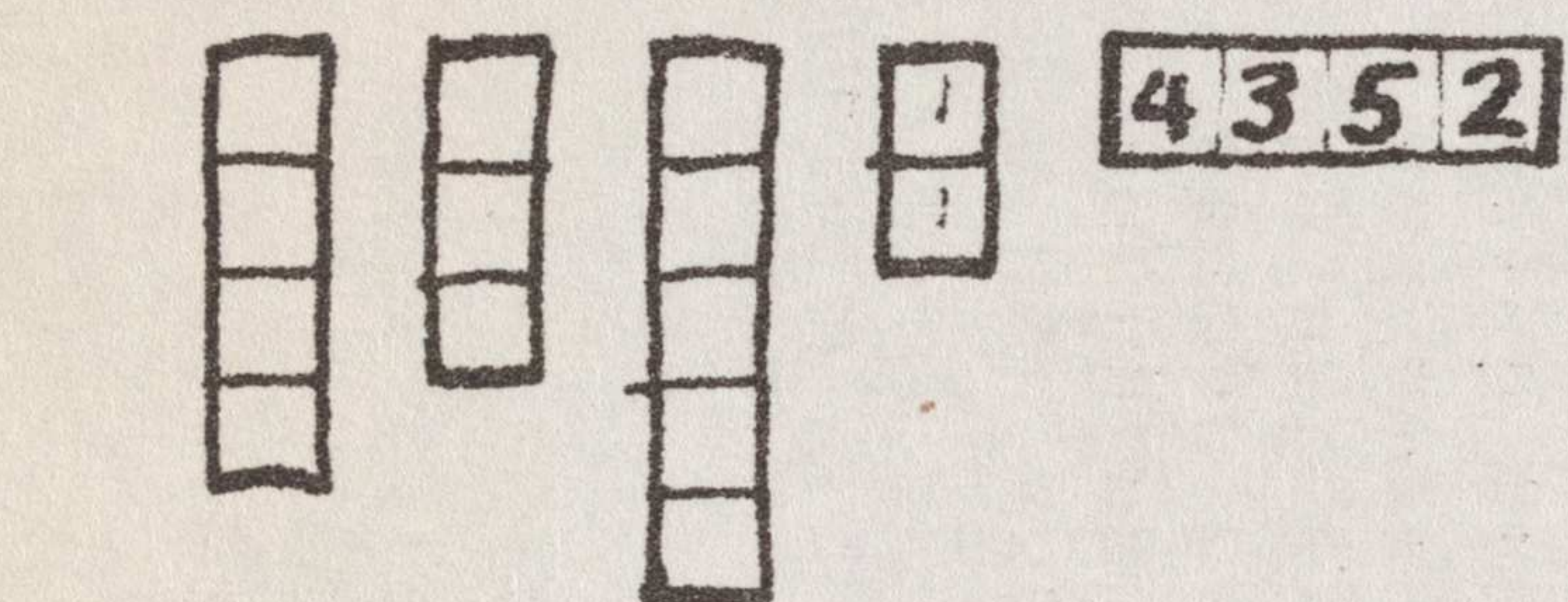
INDIRECT AIM

To develop mathematical understanding.

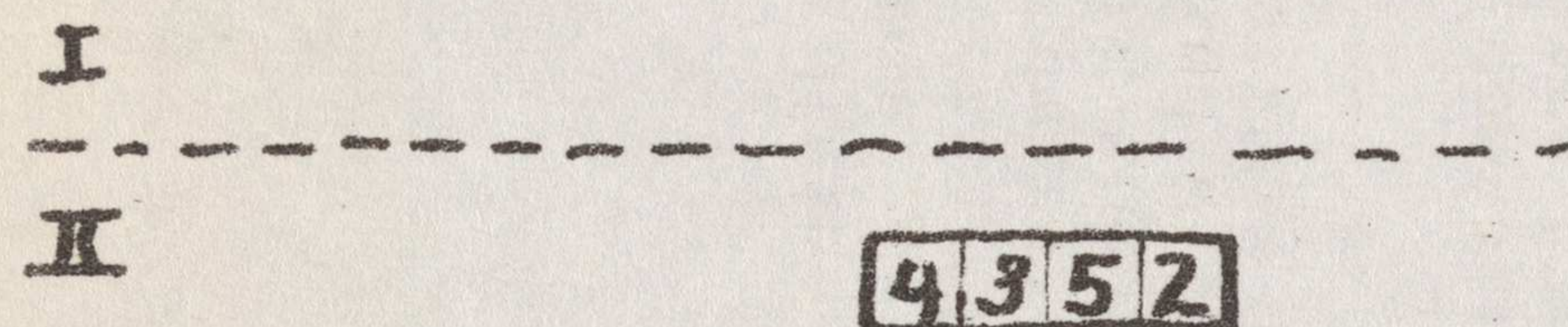
PRESENTATION

Addition

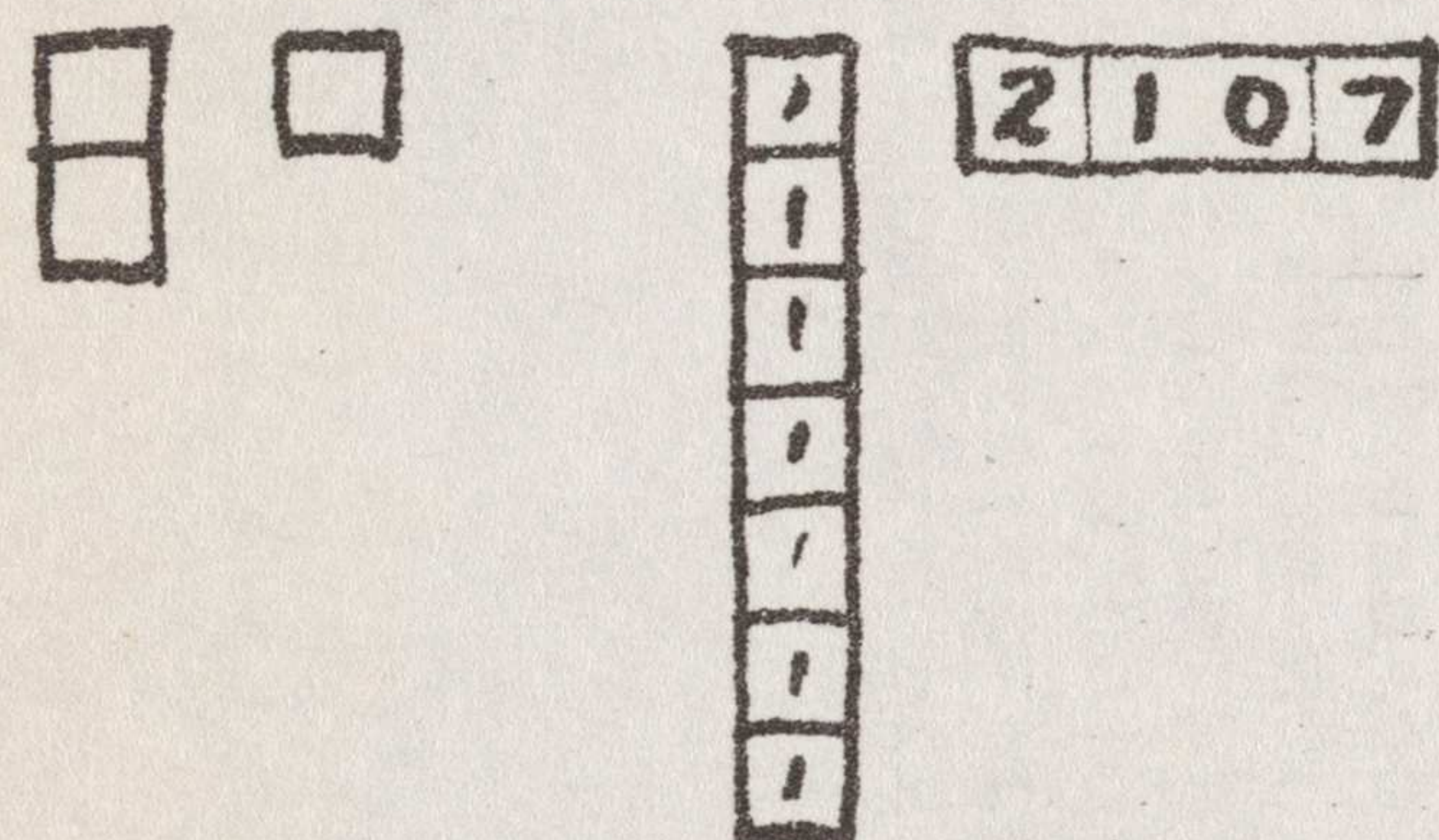
1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Have him form two numerals with the small cards.
3. Then ask him to represent each numeral by the appropriate number of stamps.
4. Now show him how to combine the stamps by grouping them into columns of like numerals. Begin the grouping with the unit stamps, continue with the stamps marked with the numeral 10, and so on.



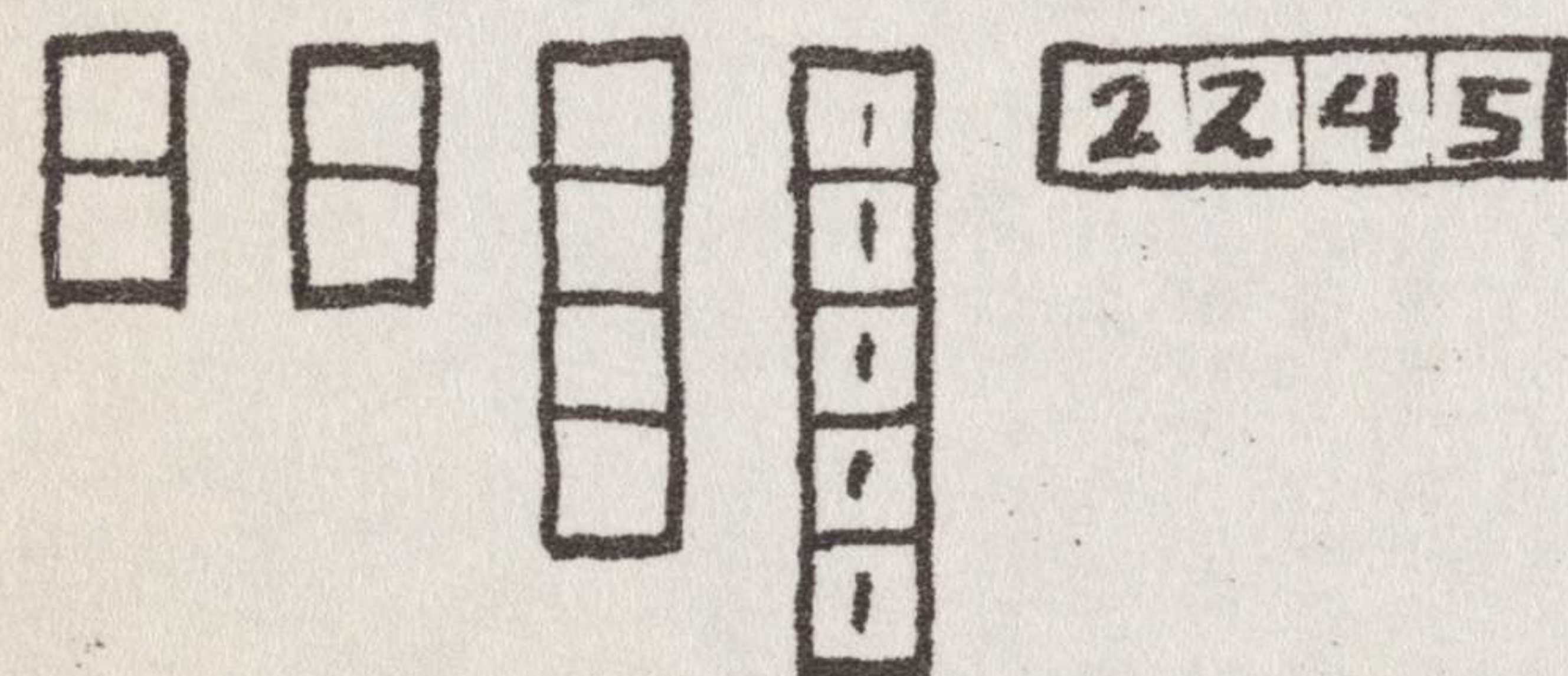
2 1 0 7



4 3 5 2

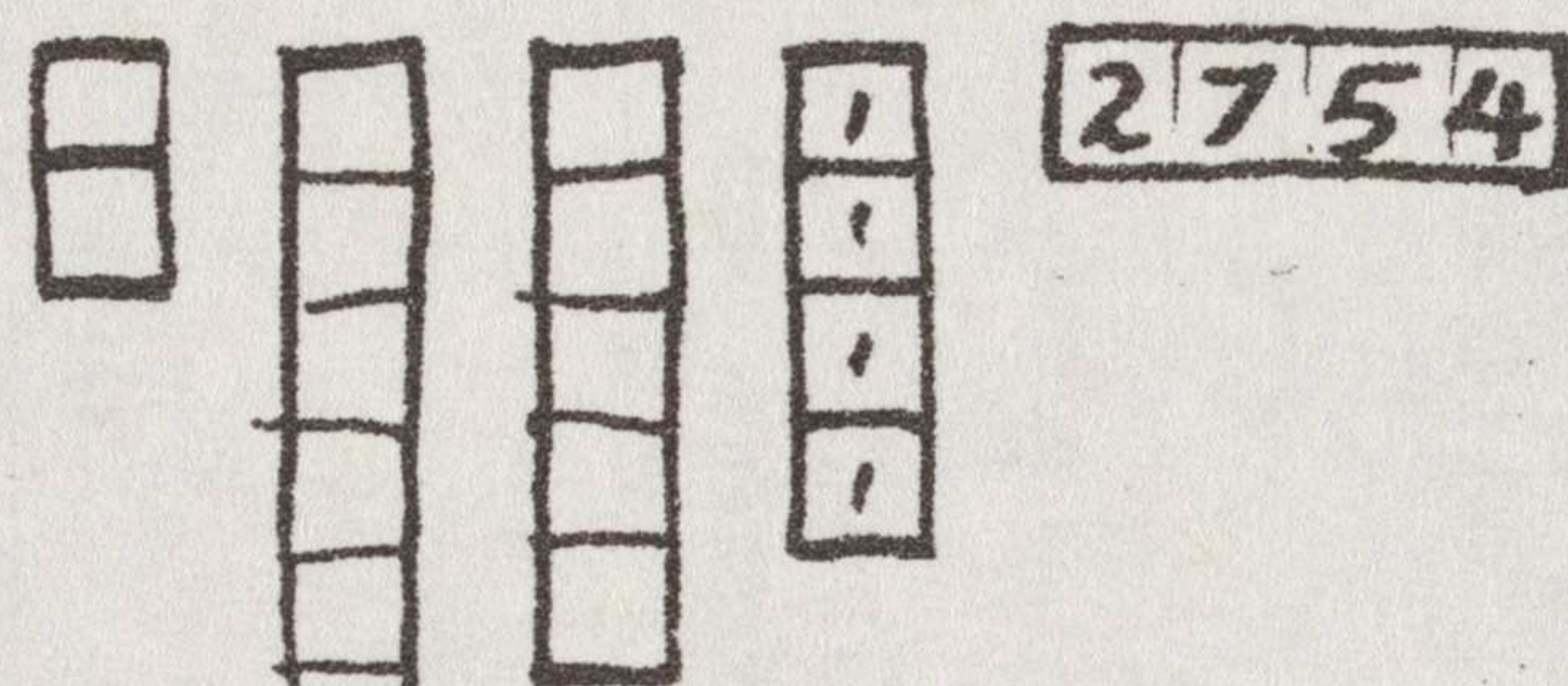


2 1 0 7

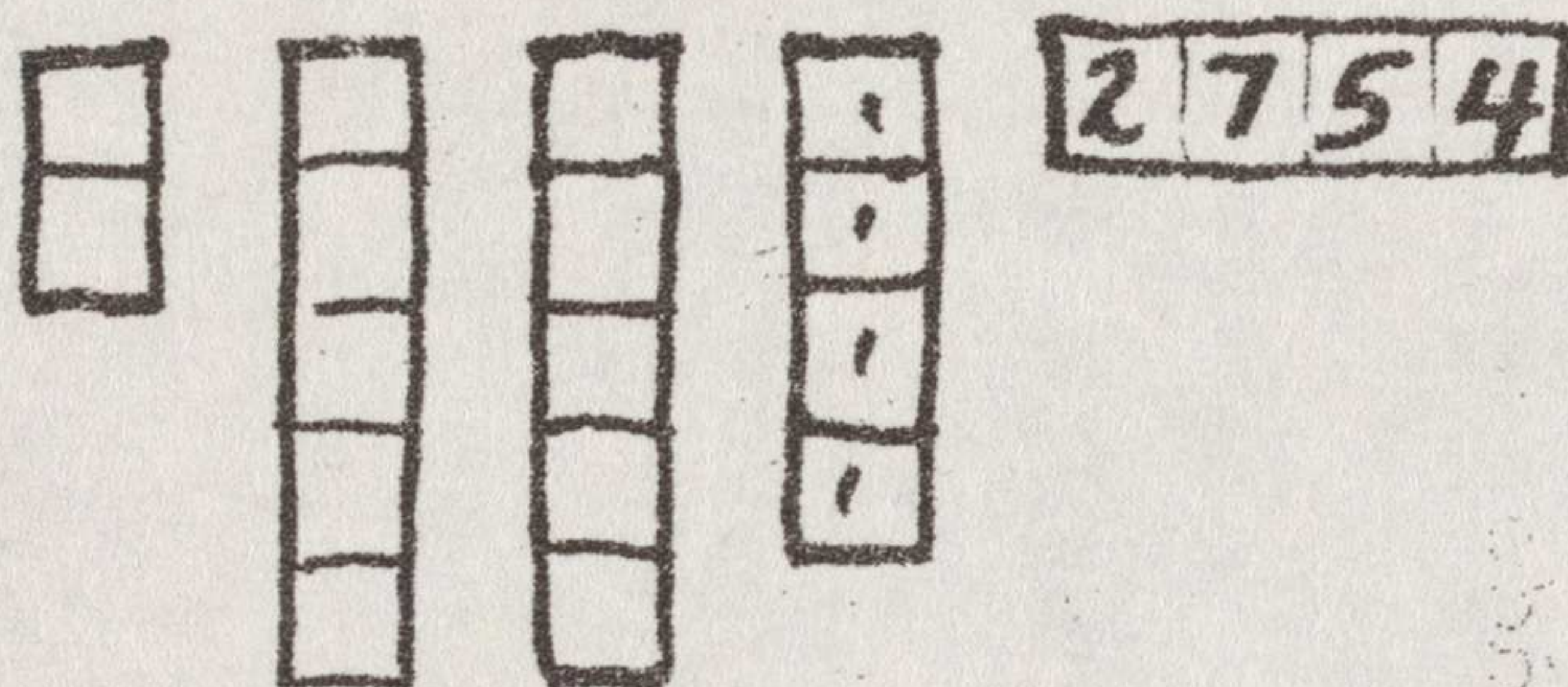


2 2 4 5

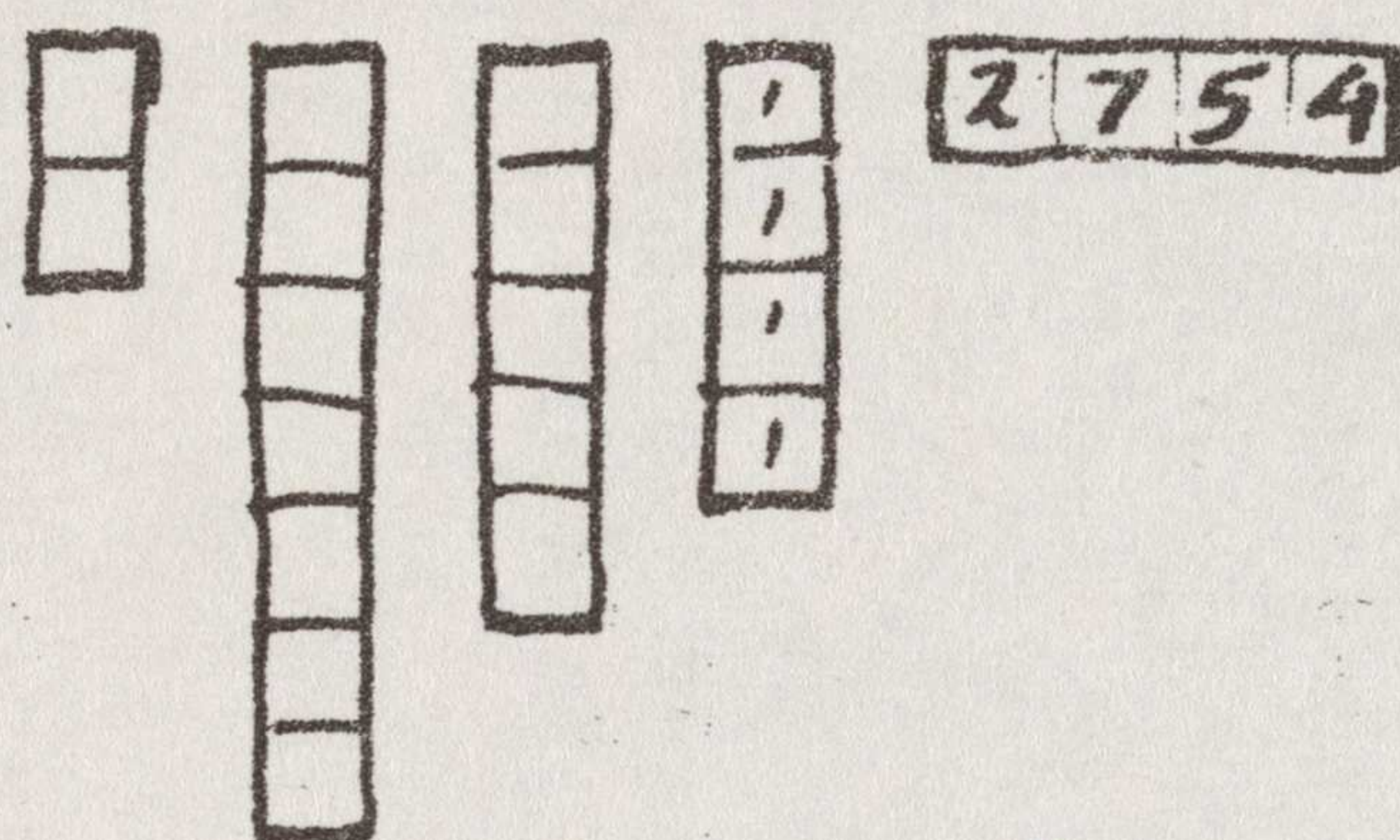
Subtraction



2 7 5 4

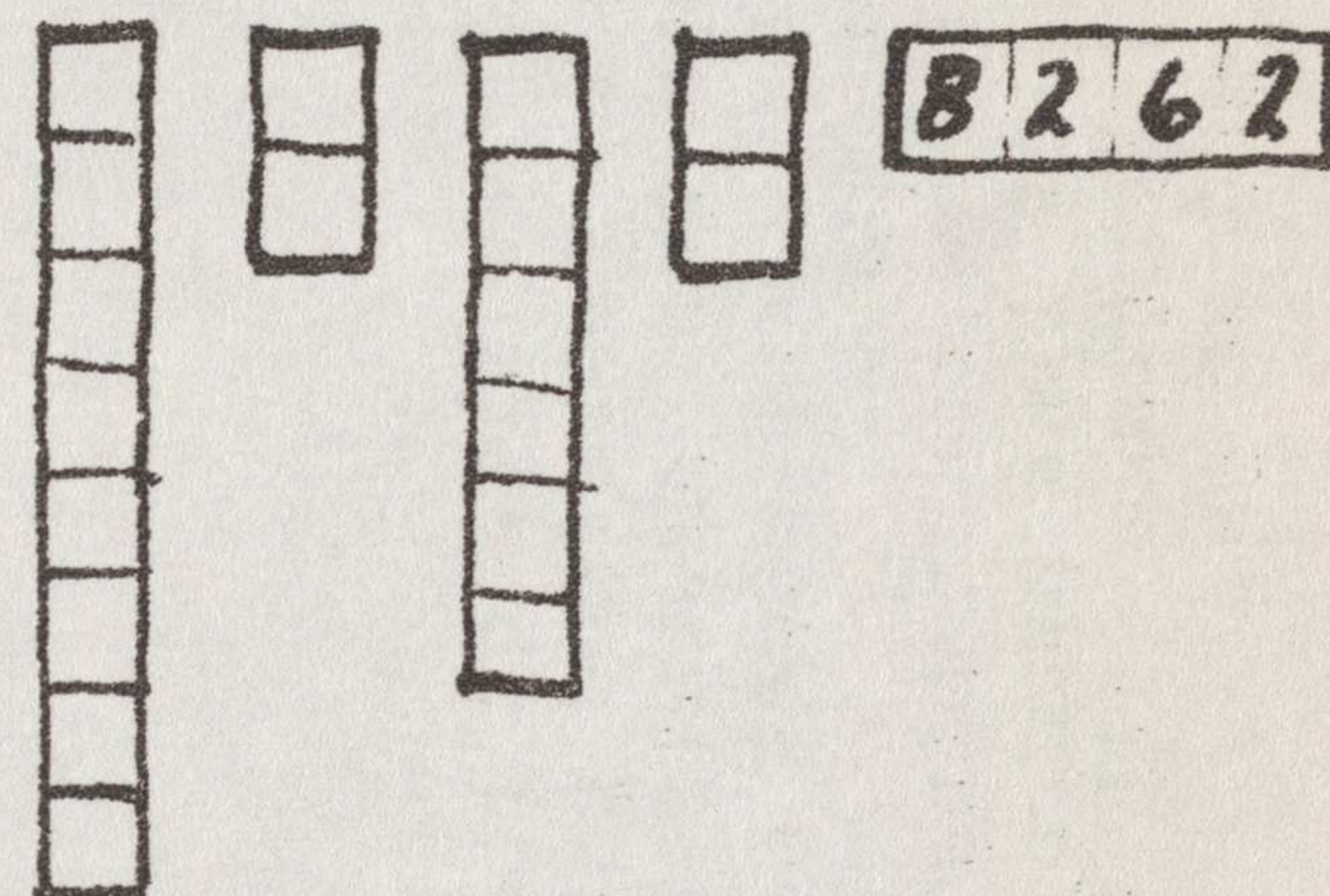


2 7 5 4



2 7 5 4

I II



8 2 6 2

Multiplication

The Stamp Game ~

STAMP GAMES - CONTINUED

5. Count the stamps making exchanges as necessary.
6. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
7. Show the child the sign card for addition.

Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

SUBTRACTION

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Have him form a numeral with the large cards.
3. Then ask him to represent this numeral by the appropriate number of stamps.
4. Form a smaller numeral with the small cards.
5. Separate from the group of stamps the number of stamps indicated by the smaller numeral.
6. Count the number of stamps that remain in the original group making exchanges as necessary.
7. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
8. Show the child the sign card for subtraction.

Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

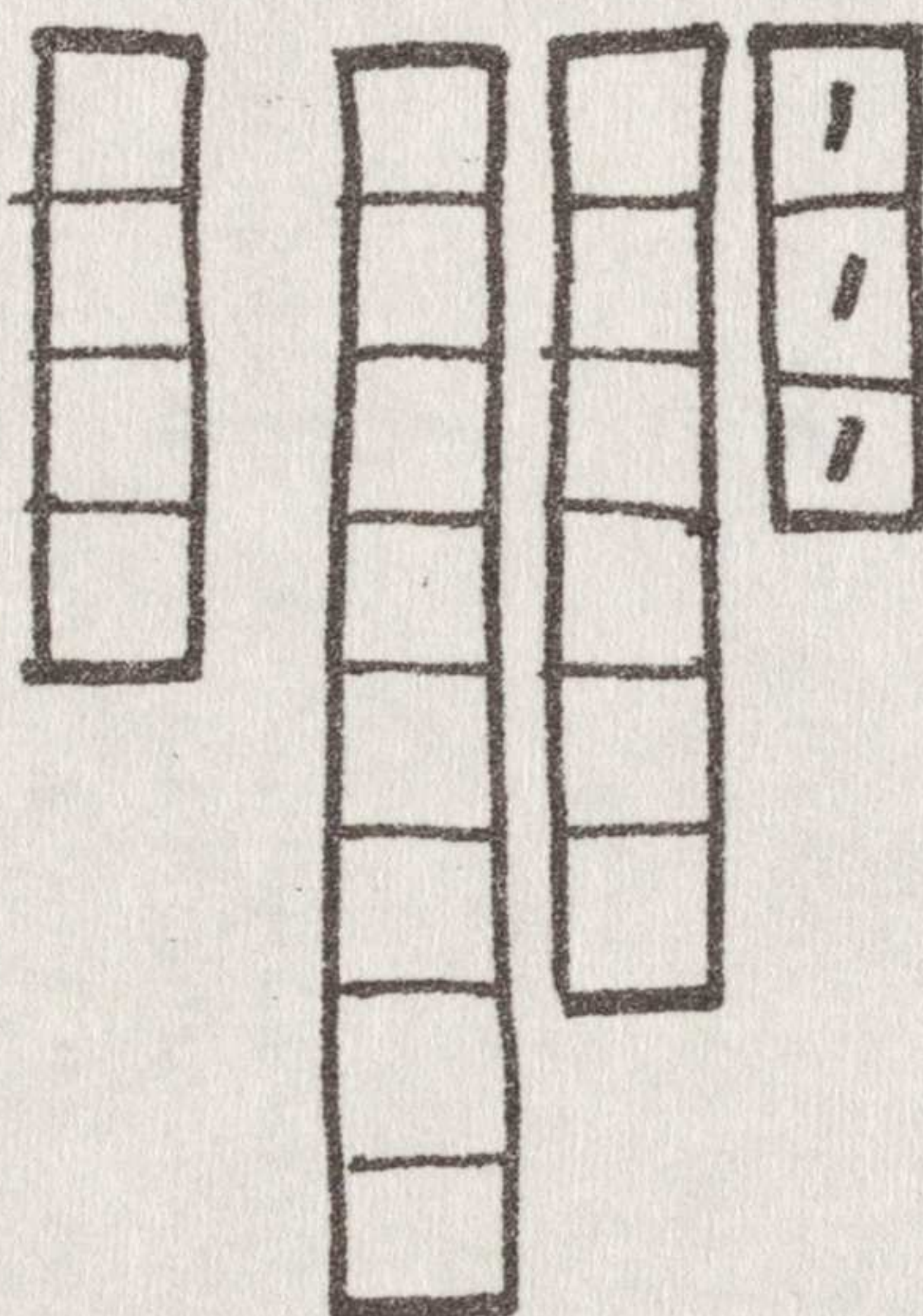
MULTIPLICATION

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Form two identical numerals with the small cards.
3. Then ask him to represent each numeral by the appropriate number of stamps.
4. Now show him how to combine the stamps by grouping them into columns of like numerals. Begin the grouping with the unit stamps, continue with the stamps marked with the numeral 10, and so on.
5. Count the stamps making exchanges as necessary.
6. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
7. Show the child the sign card for multiplication.

Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

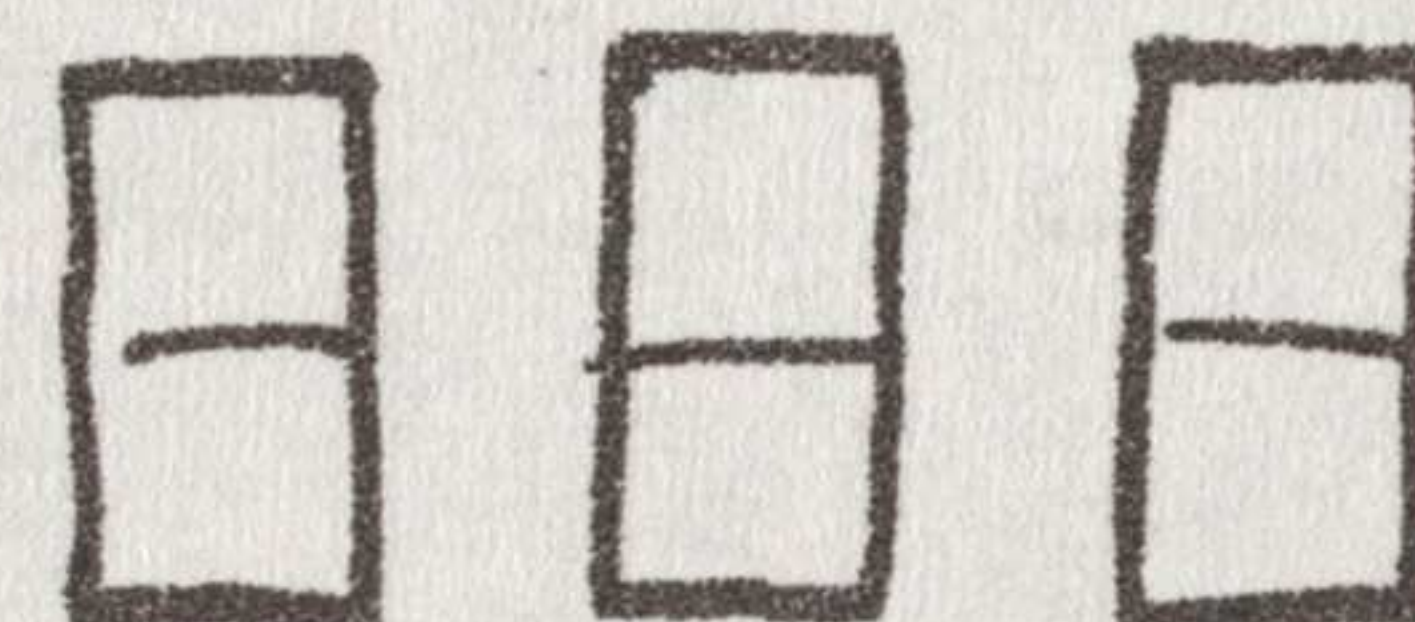
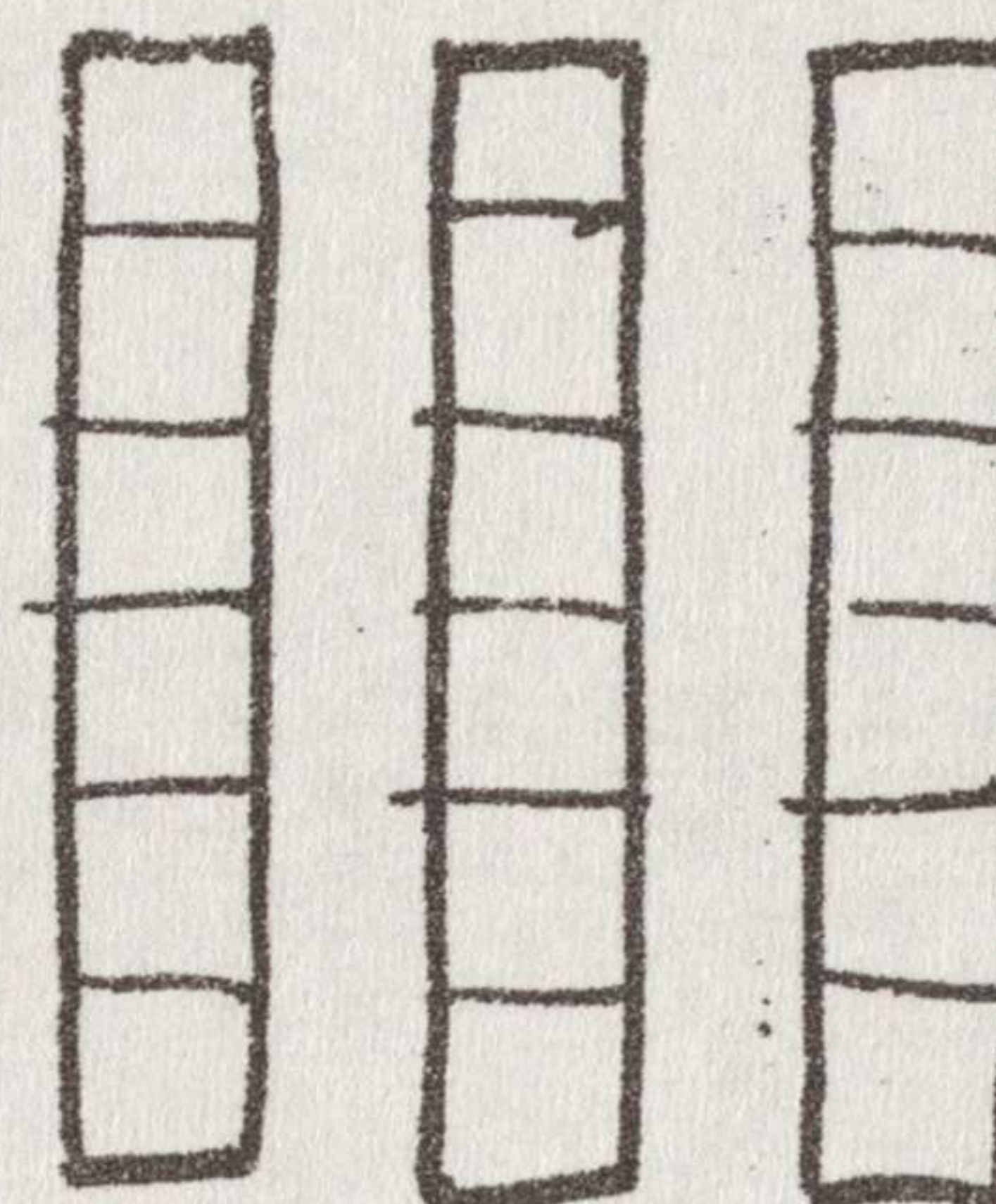
I | II

4 8 6 3 ÷ 3



4 8 6 3 ÷ 3

8 8 8



1 1 1

1 6 2 1

The Stamp Game ~ Division

STAMP GAMES - CONTINUED

DIVISION

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Have him form a numeral with the large cards.
3. Then ask him to represent this numeral by the appropriate number of stamps.
4. Explain that a small green skittle represents one unit, a small blue skittle represents one ten, a small red skittle one hundred and the large green skittle represents one thousand groups, respectively. Also explain that a green disk stands for zero groups in the unit place, a blue disk stands for zero groups in the ten place, a red disk for zero groups in the hundred place.
5. Select that combination of skittles that will represent the number of groups into which the stamp quantity is to be divided. Place the skittles in a row in order of their symbolic value.
6. Divide the stamp quantity so that each red skittle has 10 times the stamp quantity of a blue skittle; a blue skittle 10 times the stamp quantity of a green skittle. Start the division with the thousands. Make all necessary exchanges.
7. Count the stamp quantity distributed to any one of the small green skittles and note the remainder.
8. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
9. Show the child the sign card for division.

LATER EXERCISES

DIVISION

1. Show an exercise using skittles and a disk in combination.

Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

FOR ALL FOUR OPERATIONS

1. Child writes all numerals and signs instead of using cards.
2. Child writes the equation for the operation.

AGE 5 to 7 years.

CONTROL OF ERROR

The teacher.

TEENS WITH BEADS

MATERIAL

Nine gold bead bars. One short bead stair constructed of nine bead bars of the following colors and number of beads:

Bar	Number of Beads	Color
1	1	red
2	2	green
3	3	pink
4	4	yellow
5	5	light blue
6	6	brown
7	7	white
8	8	lavender
9	9	dark blue

DIRECT AIM

To teach the names of the numbers 11 through 19.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Form the numbers 11 and 12 by combining one gold bar with the red bead and one gold bar with the green bar. The short bead bars are placed to the right of the gold bars.
2. Teach the names ELEVEN and TWELVE using stage 1 of the three period lesson.
3. Mix the bars and ask the child to form twelve, then eleven.
4. Mix the bars, form eleven. Ask the child to name the number. Form twelve and ask the child to name the number.

LATER EXERCISES

1. Teach the names of the teens 13 through 19 using the procedure described above.
2. Construct the numbers 11 through 19 placing them in sequential order. Ask the child to enunciate the names of the numbers in this order.

AGE 3-1/2 to 4 years.

CONTROL OF ERROR

The teacher.

TEENS WITH BOARDS

MATERIAL

Two rectangular boards divided into five and four sections, respectively. One section is separated from another by a narrow wooden ledge. The numeral 10 is printed on each of the 9 sections.

A set of nine wooden tablets, each half the width of a board, on which are printed the numerals 1 through 9.

DIRECT AIM

To teach the names of numerals 11 through 19.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Form the numerals 11 and 12 by sliding the tablets marked 1 and 2 over the zeros in the top two sections of the longer board.
2. Teach the names ELEVEN and TWELVE using stage 1 in the three period lesson.
3. Mix the tablets and ask the child to form 12, then 11.
4. Mix the tablets, form 11, ask the child to name this numeral. Form 12 and ask the child to name this numeral.

LATER EXERCISES

1. Teach the names of the numerals 13 through 19 using the procedure described above.
2. Construct the numerals 11 through 19 placing them in sequential order. Ask the child to enunciate the names of these numerals in order.

AGE 3-1/2 to 4 years.

CONTROL OF ERROR

The teacher.

Teens







1	1
1	2
1	3
1	4
1	5










1	6
1	7
1	8
1	9

TEENS WITH BEADS AND BOARDS

MATERIAL

Nine gold bead bars. A short bead stair. Teen boards and tablets.

DIRECT AIM

To associate the numbers 11 through 19 with the numerals 11 through 19.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

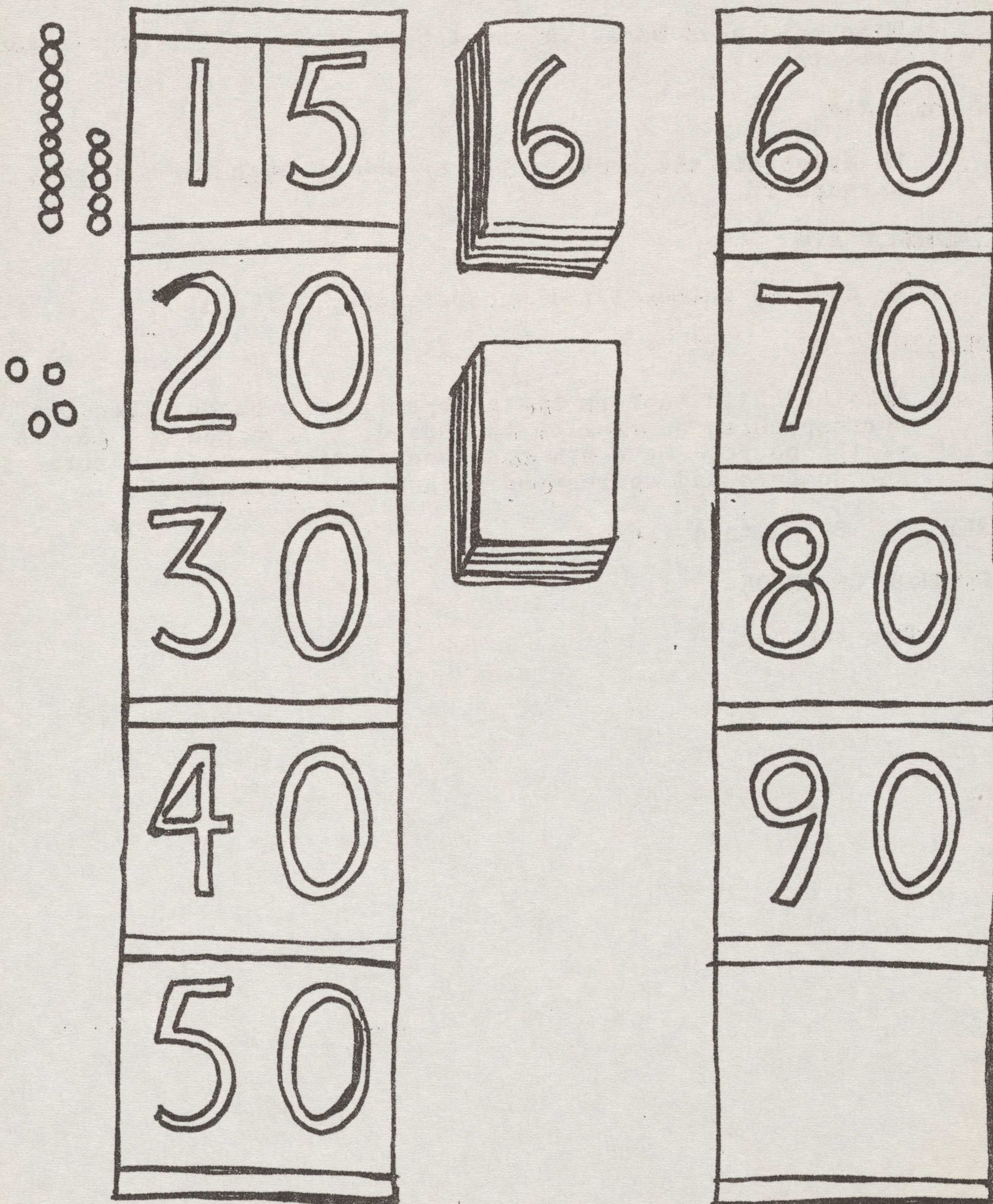
Ask the child to form the number 11 with beads, then the corresponding numeral on the board. The beads lie to the left of the board. Have him continue in this manner to form all the numbers and corresponding numerals through 19.

AGE 3-1/2 to 4 years.

CONTROL OF ERROR

The teacher.

Tens



TENS WITH BEADS AND BOARDS

MATERIAL

45 gold bead bars and 10 gold beads. Two rectangular boards divided into five and four sections, respectively. One section is separated from another by a narrow wooden ledge. The numerals 10 through 90 are printed on the nine sections. A set of 9 wooden tablets, each half the width of a board, on which are printed the numerals 1 through 9.

DIRECT AIM

1. To teach the names 20, 30, 90.
2. To associate these numbers with the corresponding numerals.
3. To teach counting from 10 through 90.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

WITH BEADS:

1. Form the numbers 20 and 30 using the gold bead bars. Teach the names TWENTY and THIRTY using stage 1 in the three period lesson.
2. Mix the bars and ask the child to form 30 then 20.
3. Ask the child to name the numbers 20 and 30.
4. As later exercises, teach the names of the numbers 40 through 90 following the above procedure.

WITH BOARDS:

1. Teach the names of the numerals 20 and 30 using the three period lesson.
2. As later exercises, teach the names of the numerals 40 through 90 using the three period lesson.

WITH BEADS AND BOARDS:

Ask the child to form the number 10 with beads and place it to the left of the corresponding numeral on the board. Have him continue in this manner until all the numbers corresponding to the numerals on the boards have been formed.

LATER EXERCISES

Form all the numbers 11 through 99, using bead bars and single beads, and the corresponding numerals, using the boards and tablets. Form these numbers and numerals in sequential order. Form 20 employing one bar and all 10 loose beads. Before proceeding to form 21, replace the 10 loose beads with one bead bar moving the two bead bars to the left of 20 on the board. Proceed in like manner to replace loose beads by a bar before forming 31, 41 ... 91.

AGE 3-1/2 to 4-1/2 years.

CONTROL OF ERROR The teacher.

CHAIN OF 100

MATERIAL

Ten bead bars, of 10 beads each, linked to form a chain. A bead square made of 10 bead bars. A red envelope containing three sets of labels with each label pointed at one end. One set of 9 green labels on which are printed the numerals 1 through 9; one set of 9 blue labels on which are printed the numerals 10, 20....., 90; and one red label on which is printed the numeral 100. The sets of 9 labels each are held together by rubber bands.

Long rolls of square-ruled paper about 2 inches wide and lead pencils.

DIRECT AIM

To show the child the square of ten.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Place the labels on a rug and order them in numerical sequence.
2. Arrange the chain in a straight line on the floor.
3. Fold the chain to form a square.
4. Compare this square with the other bead square.
5. Unfold the chain so that it lies in a straight line with the bead square at one end of the chain.
6. Ask the child to assist you in counting the number of beads in the chain. Begin counting from the end of the chain that lies away from the bead square. Place the green labels in numerical sequence to the right of the first 9 beads with the pointed ends touching the beads. Place the blue label that is marked with the numeral 10 to the right of the 10th bead, the blue label marked 20 to the right of the 20th bead, and so on to 90. Place the red label to the right of the 100th bead.
7. Ask the child to count the chain in tens by reading the blue and red labels.

NOTE: Emphasize that the chain contains ten tens or one hundred beads and can be made to form a square with ten beads to a side.

LATER EXERCISE

Ask the child to write on a long roll of square-ruled paper all the numerals in their proper sequence from 1 to 100.

CHAIN OF 1000

MATERIAL

One hundred bead bars of 10 beads each, linked to form a chain. Each 100 beads are separated from another 100 by a double link. Ten bead squares, each made of 10 bead bars. One bead cube made of 10 bead squares. A green envelope containing four sets of labels, with each label pointed at one end. One set of 9 green labels on which are printed the numerals 1 through 9; one set of 9 blue labels on which are printed the numerals 10, 20,, 90; one set of 90 red labels on which are printed the numerals 100, 110, 000 200, 210, 0000, 900; and one green label on which is printed 1000.

Long rolls of square-ruled paper about 2 inches wide and lead pencils.

DIRECT AIM

To show the child the structure of the CUBE of ten.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Place the labels on a rug and order them in numerical sequence.
2. If possible, arrange the chain in a straight line on the floor.
3. Fold the chain to form ten squares.
4. Place on top of each of these squares one of the other bead squares. Use the latter bead squares to form a cube. Compare the cube just formed with the other bead cube.
5. Unfold the chain so that it lies with the bead cube at one end of the chain.
6. Ask the child to assist you in counting the number of beads in the chain.
7. Begin counting from the end of the chain that lies away from the bead cube. Place the labels in numerical sequence to the right of the beads.
8. Ask the child to count the chain in tens by reading the blue and red labels and green label marked 1000.

NOTE: Emphasize that the cube of ten has ten beads to a side and contains one thousand beads.

LATER EXERCISES

1. Compare this chain with the chain of 100 beads by placing them alongside each other.
2. Ask the child to write on a long roll of square-ruled paper all the numerals in their proper sequence 1 to 1000.

AGE 4 to 5-1/5 years

CONTROL OF ERROR

The teacher.

BEAD CHAINS OF VARYING LENGTH

MATERIAL

A number of bead chains, each of which when folded will form bead squares that represent the quantities 1^2 , 2^2 , 3^2 ,, 9^2 .

A number of bead chains, each of which when folded will form the number of bead squares necessary for construction of bead cubes that represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

A series of bead squares. Each series contains the number and size of squares that are necessary to construct the bead cubes that will represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

A number of bead cubes to represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

A number of bead cubes to represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

The colors of the beads that compose the chains, squares and cubes vary with quantities represented as follows:

<u>Quantity</u>	<u>Color</u>
1	red
2	green
3	pink
4	yellow
5	light blue
6	brown
7	white
8	lavender
9	dark blue

For every section in a chain there is a label marked with the numeral that represents the quantity of beads in that section. Every label is of the same color as the beads in the section that it belongs to.

A small card, made of cardboard and provided with a notch, that is to be used in counting.

DIRECT AIM

To show the difference in quantities between the squares and cubes of the numbers 1, 2,, 9 by counting beads.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Select any number between 1 and 9, inclusively, and bring the chains, squares, the cube and the labels that are of the corresponding color.

BEAD CHAINS OF VARYING LENGTH - CONTINUED

2. Place the labels for each chain in numerical sequence.
3. Arrange each chain in a straight line so that a comparison of their length can be made.
4. Fold the shorter chain to form a square. Superimpose a bead square on this formation to show that both have the same quantity of beads.
5. Unfold the chain to form again a straight line.
6. Ask the child to count the beads in the chain by using the notched card. As he is counting, have him place the appropriate label at the end of every section and to the right of it.
7. Fold the longer chain to form a number of squares. Superimpose a bead square on each formation to show that they have the same quantity of beads.
8. Remove the bead squares and form a cube from them. Compare this formation with the bead cube.
9. Unfold the chain to form again a straight line.
10. Ask the child to count the beads in the chain. As he is counting have him place the appropriate label at the end of every section and to the right of it.
11. Ask the child to count the number of beads in the shorter chain by having him enunciate the numerals that are printed on the labels. Ask him to count the number of beads in the longer chain in the same manner.

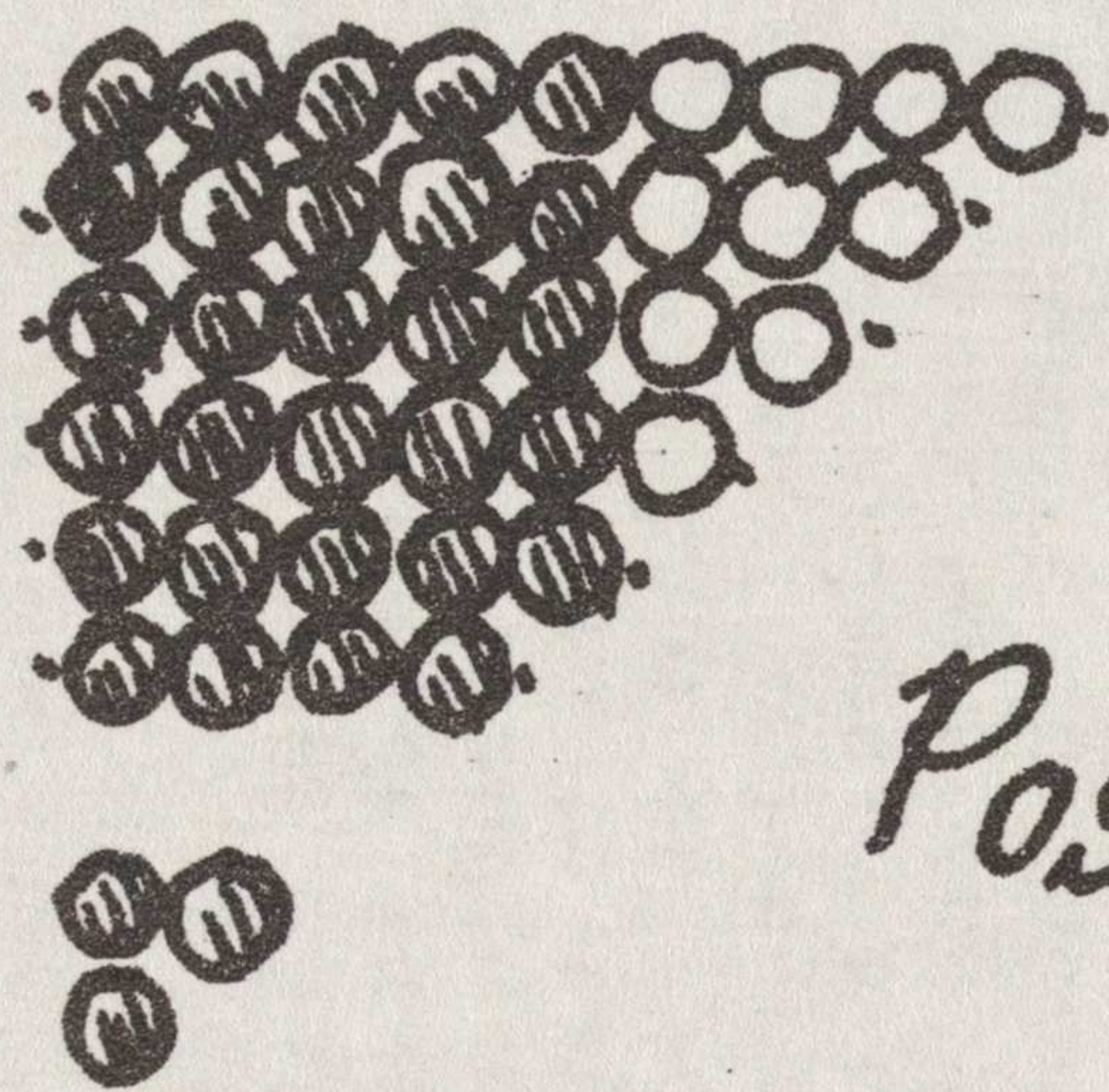
NOTE: Emphasize the structure of the square of a number and
LATER EXERCISES of the cube of a number.

1. Have the child repeat the exercise in the above described manner for each number in the series 1 through 9.
2. Arrange all the shorter chains in order of length by placing the first bead in each chain along a horizontal straight line.
3. Arrange the longer chains in the same manner.

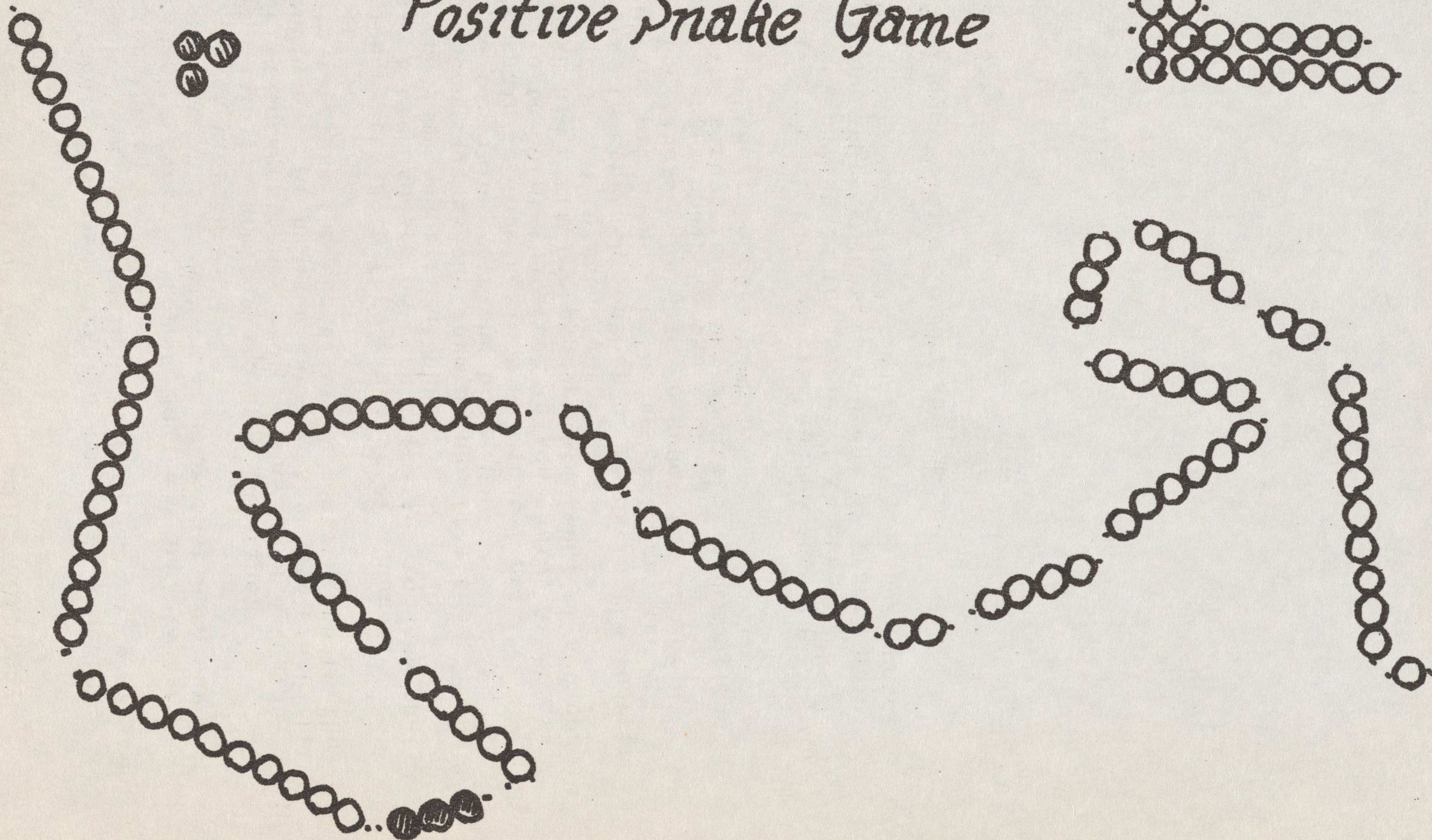
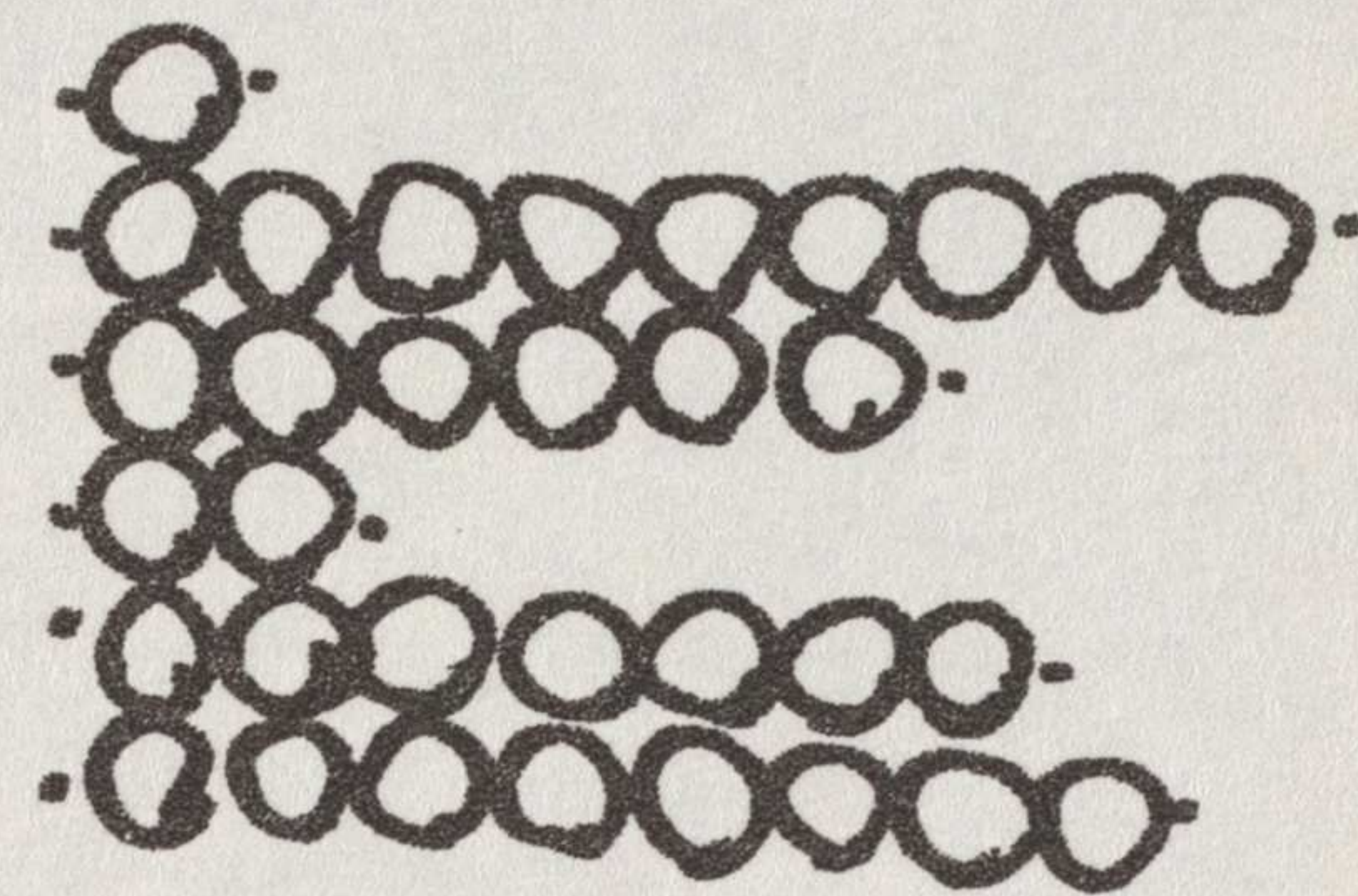
AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The teacher.



Positive Snake Game



SNAKE GAME

MATERIAL

- A number of colored short bead stairs in a wooden box.
- A number of bead strirs each composed of nine bead bars.
- The bars that have 5 or less beads are colored black.
- The bars that have more than five beads are colored black and white, with the number of black beads always 5.
- A number of gold bead bars of 10 beads each.
- A bead square composed of 10 gold bead bars.
- A small notched card.

DIRECT AIM

To perform the operation of addition on numbers less than 10 as an introduction to the addition table.

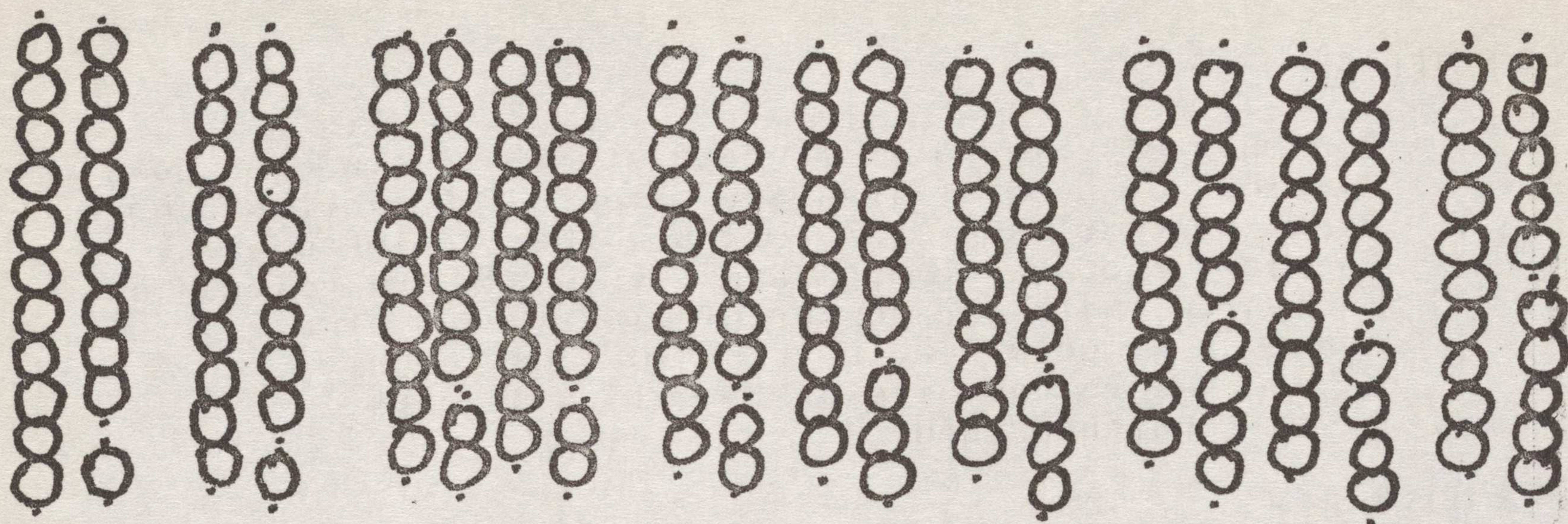
INDIRECT AIM

To develop mathematical understanding.

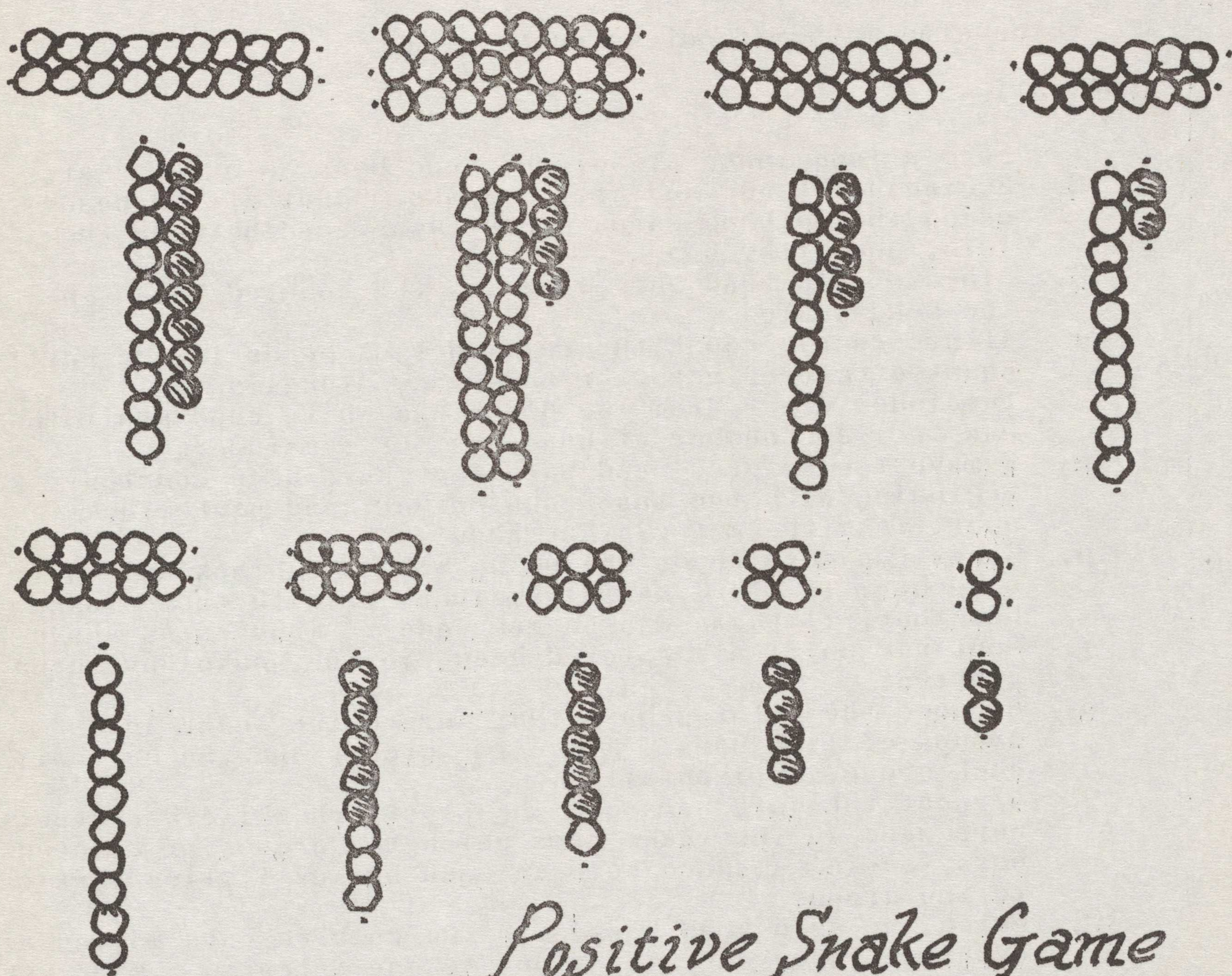
PRESENTATION

1. Form a long snake of colored bead bars on a felt mat.
2. Beginning at one end of the snake, count off 10 beads using the notched card. Insert the card between the 10th. and 11th. beads.
3. Place a gold bead bar alongside the counted beads in the bead snake.
4. If necessary, count the remainder of beads in the partly-counted colored bead bar and place alongside this remainder a bar from the black and white bead stair that has the same number of beads as the remainder.
5. Remove the colored bead bars that have been counted, beginning with the last counted bar, and place them apart from the material at hand.
6. Count ten more beads beginning with the black and white bead bar, if there was a remainder or with the colored bead bar, if there was no remainder. Proceed as above.
7. Continue until all colored beads in the snake have been counted.
8. Arrange the colored bars that formed the snake into groups of like bars. Place the groups and the bars within each group, horizontally.
9. Arrange the gold bars and the black and white bars that were used in the snake game below the groups of colored bars leaving a space between each bar as it lies vertically to the groups.
10. Match the gold bead bars with the colored bars making all exchanges necessary for a one-to-one matching. Place the colored bars alongside the gold bars.

Verification I



Verification II



Positive Snake Game

SNAKE GAME - CONTINUED

NOTE: A one-to-one matching will only be possible if no mistakes were made in the counting.

LATER EXERCISES

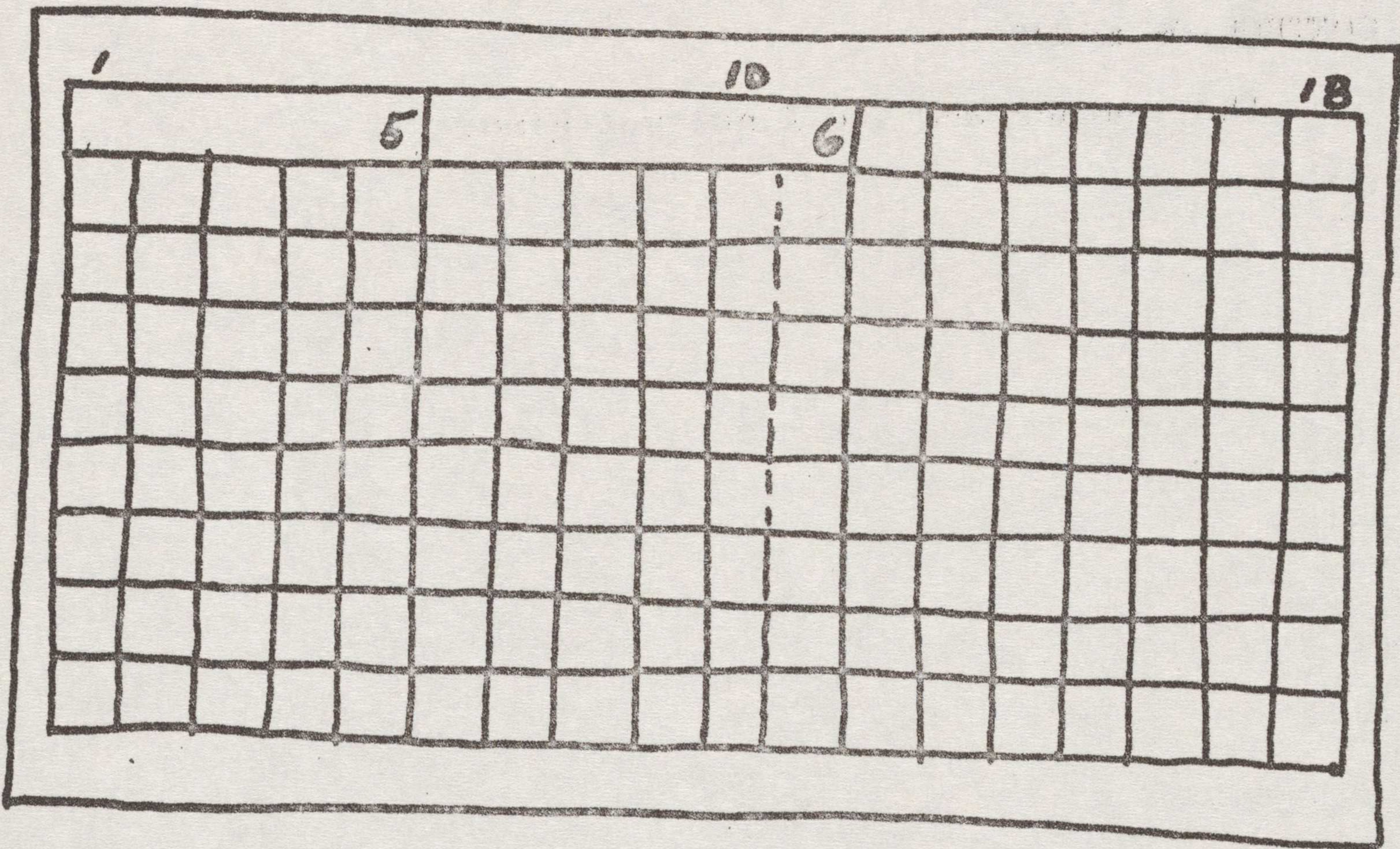
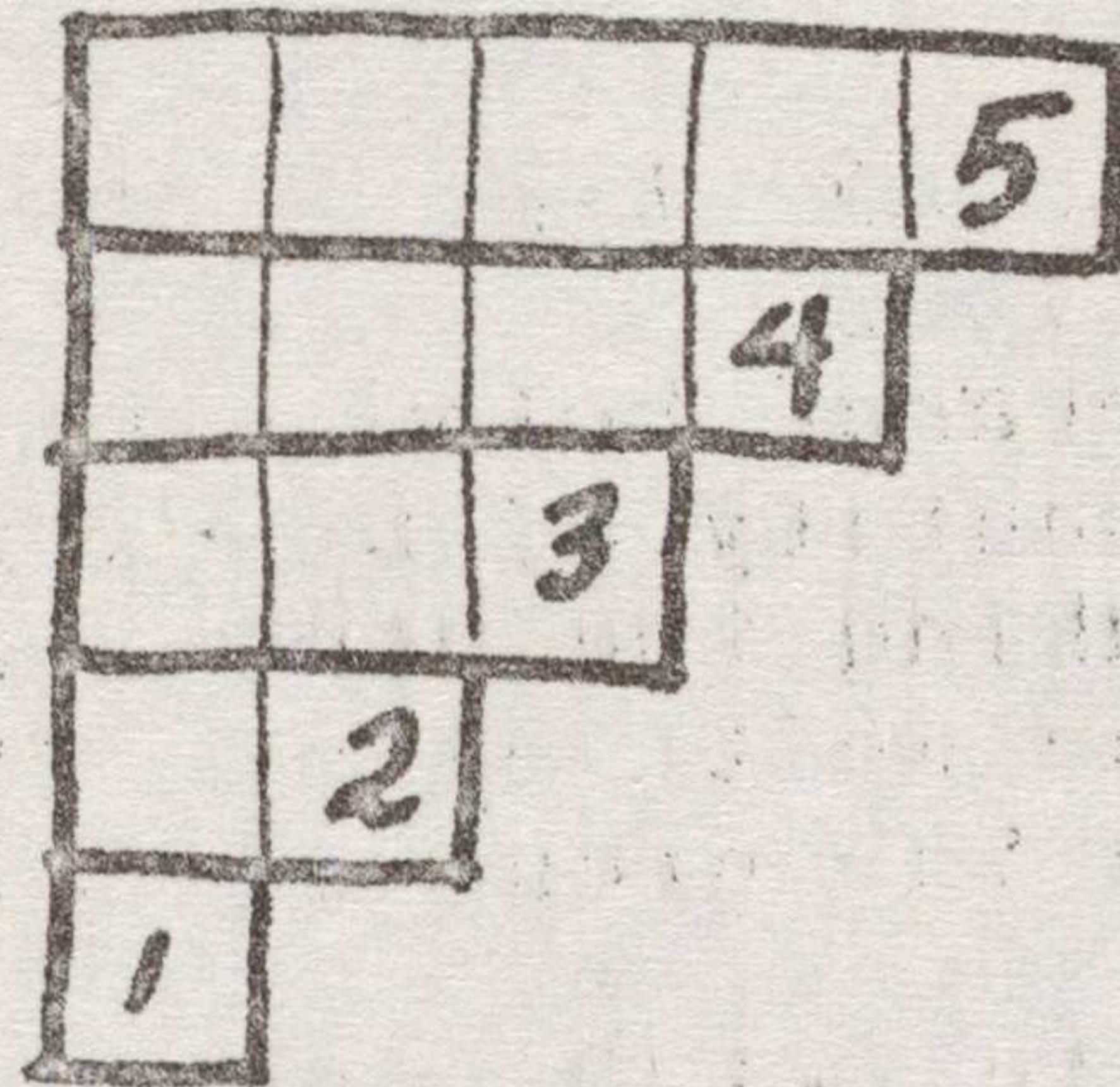
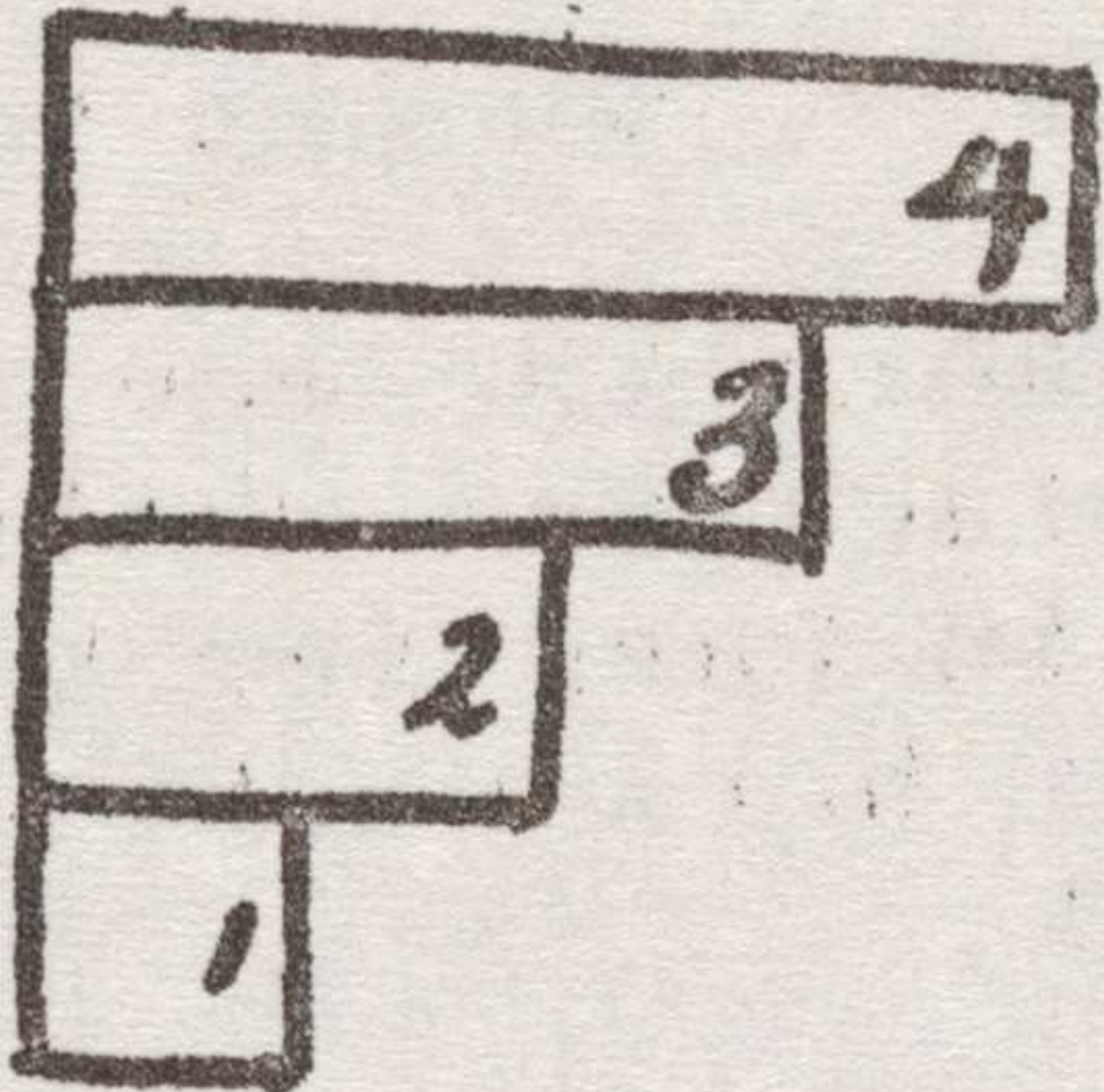
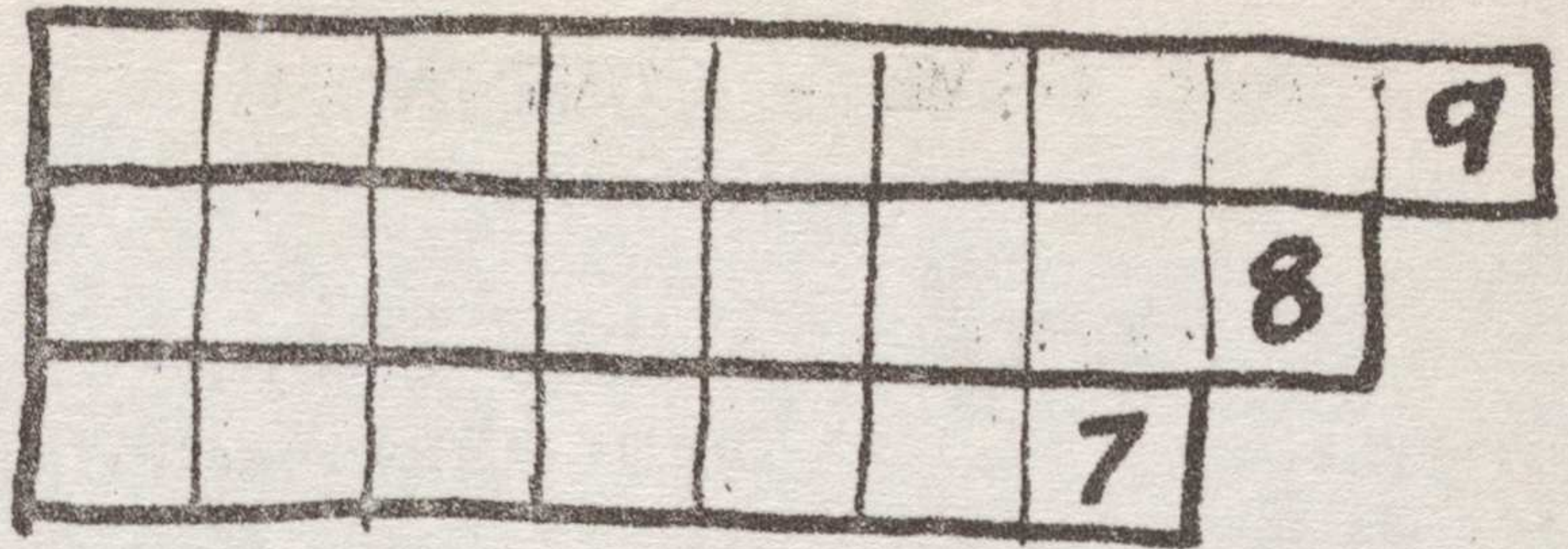
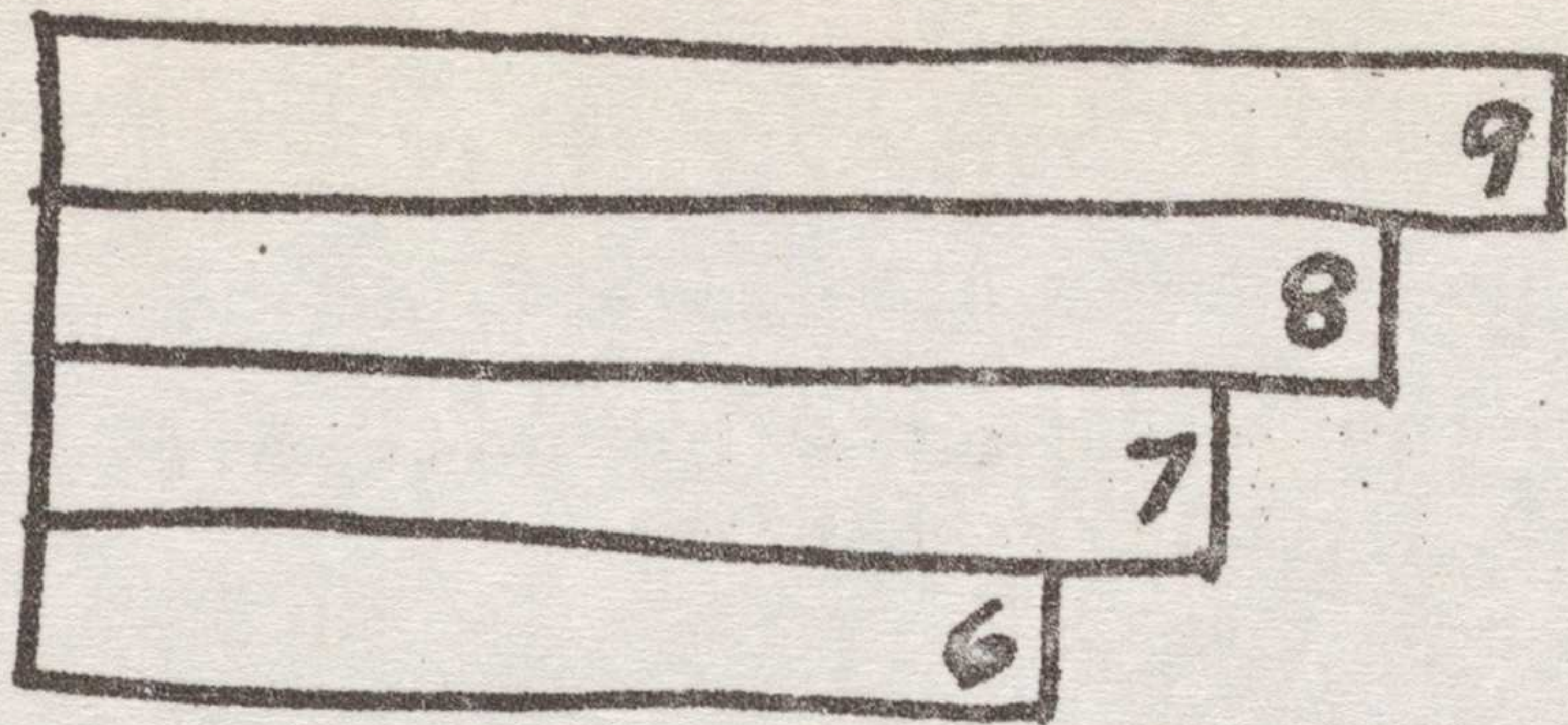
Instead of steps 8 and 9 as described above, do the matching as follows:

Arrange below each group of colored bars the equivalent quantity of beads in gold bars and black and white bars, making the necessary exchanges of gold bars for black and white bars. Place the equivalent bars vertically to the group of colored bars above it.

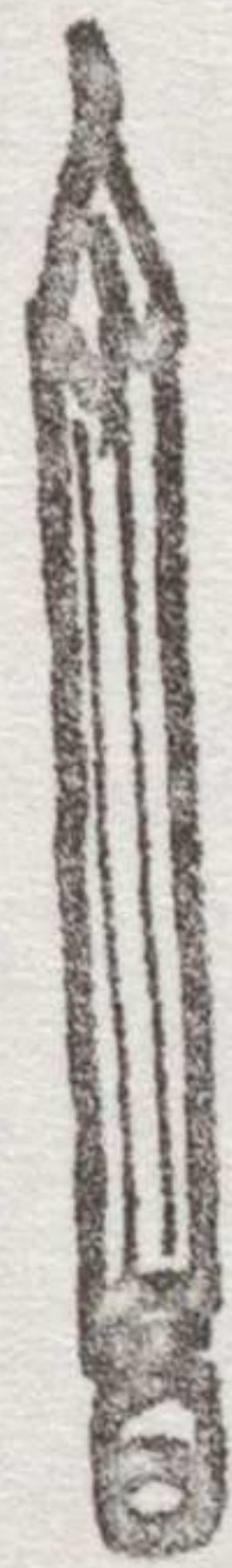
AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The teacher and the final matching.



Addition Strip Board



	5	
5+1.		6
5+2.		7
5+3.		8
5+4.		9
5+5.		10
+6.		
+7.		
+8.		
+9.		

STRIP BOARD - ADDITION

MATERIAL

Rectangular wooden board with the numerals 1 to 10 printed in red and the numerals 11 to 18 printed in black across the top as columnar headings. The board is divided into 2 cm squares - 9 down and 18 across. Columns 10 and 11 are separated by a heavy line.

A set of blue wooden strips, 2cm wide and from 2cm to 18cm long. Each strip has one of the numerals 1 to 9 printed at the right end. The shortest strip has the numeral 1 and the longest the numeral 9 printed on it.

A set of red wooden strips, 2cm wide and from 2cm to 18cm long. Each strip is divided into 2cm squares and has one of the numerals 1 to 9 printed in the right end square. The shortest strip has the numeral 1 and the longest has the numeral 18.

A set of 18 blank unpainted wooden strips, 2cm wide and from 2cm to 36cm long.

A number of slips of paper each of which looks as follows:

+1=

+2=

+3=

+4=

+5=

+6=

+7=

+8=

+9=

Chart 1 is an addition table of all possible permutations of the numbers 1 through 9, taken two at a time. The sums of 10 are printed in red along the positive sloped diagonal.

Chart 2 is an addition table that shows the sums for all combinations of the numbers 1 through 9, taken two at a time. The sums of 10 are printed in red along the horizontal divider of the table.

DIRECT AIM

To construct the above described addition tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Arrange the strips of each set in numerical sequence.
2. Place the blue strip marked with the numeral 1 in the first row of the first column on the wooden board. Place the

STRIP BOARD - ADDITION - CONTINUED

- red strip marked with the numeral 1 in the first row of the second column. Read the result of the addition $1+1$ in the square above the numeral on the red strip.
3. Continue replacing the red strips to form the sum $1+2$, $1+3$, $1+4$,, $1+9$. In each case, read the result of the addition in the square above the numeral on the red strip.
 4. Repeat the exercise recording the first addend and the result of each addition on the slip of paper provided for this purpose.
 5. Check the results against chart 1.

LATER EXERCISE

1. Ask the child to form all sums using as first addend 2, then 3 then 9. Have him record the result of each addition as before.
2. Select a sum not greater than 18 and from all possible permutations of two numbers that will add to this sum. After selecting the sum, place the blank strip on the numbered row of the board so that all numerals to the right of the selected sum are masked. Record both addends and the sum for every permutation.
3. Show the child that addition is a commutative operation.
4. Have the child record all possible combinations of two numbers that form a given sum not greater than 18. Check the results against chart 2.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Charts 1 and 2 and the teachers

CHARTS - ADDITION

MATERIAL

Three addition tables and one blind chart as illustrated by N. Newkirk. Throughout this exercise, these will be referred to as chart 3, 4, and 5. The blind chart will be referred to by this name. Charts 1 and 2, referred to in the previous exercise, will serve as control devices.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of chart 3. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written all possible permutations, taken two at a time of the numbers 1 to 9, with a plus sign between any two numbers and an equal sign after the second addend. The results of the additions are not given. There is one slip of paper for each permutation.

A second basket containing folded slips of paper on which are written all possible combinations, taken two at a time, of the numbers 1 to 9, with a plus sign between any two numbers and an equal sign after the second addend. In every combination the first addend is smaller than or equal to the second addend. There is one slip of paper for each combination.

Pencils and square-ruled paper.

DIRECT AIM

To use various forms of addition tables in order to have the child memorize the results of the addition operations that are contained in these tablets.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Have the child pick a slip of paper from the first basket and copy what is written on it onto a sheet of square-ruled paper.
2. He finds the answer to the addition on chart 3, recording it after the equal sign on his paper. The answer on chart 3 is located at the intersection of the column numbered by the first addend with the row numbered by the second addend.
3. The child continues in this manner until he tires of the exercise.
4. Then he checks the results written on his paper by comparing them with those on chart 1, and makes any necessary correction.

CHARTS - ADDITION - CONTINUED

LATER EXERCISES

1. Have the child use the second basket in conjunction with charts 4 and 2.
2. Have the child use the second basket in conjunction with charts 5 and 2.
3. Use either basket in conjunction with the blind chart and chart 3 as follows:
 - a) child picks a slip of paper from either basket;
 - b) mentally completes the addition;
 - c) places the tablet that describes this sum into the appropriate square on the blind chart;
 - d) after doing many examples the child checks for correctness of results with chart 3.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Charts 1, 2 and 3 and the teacher.

Addition

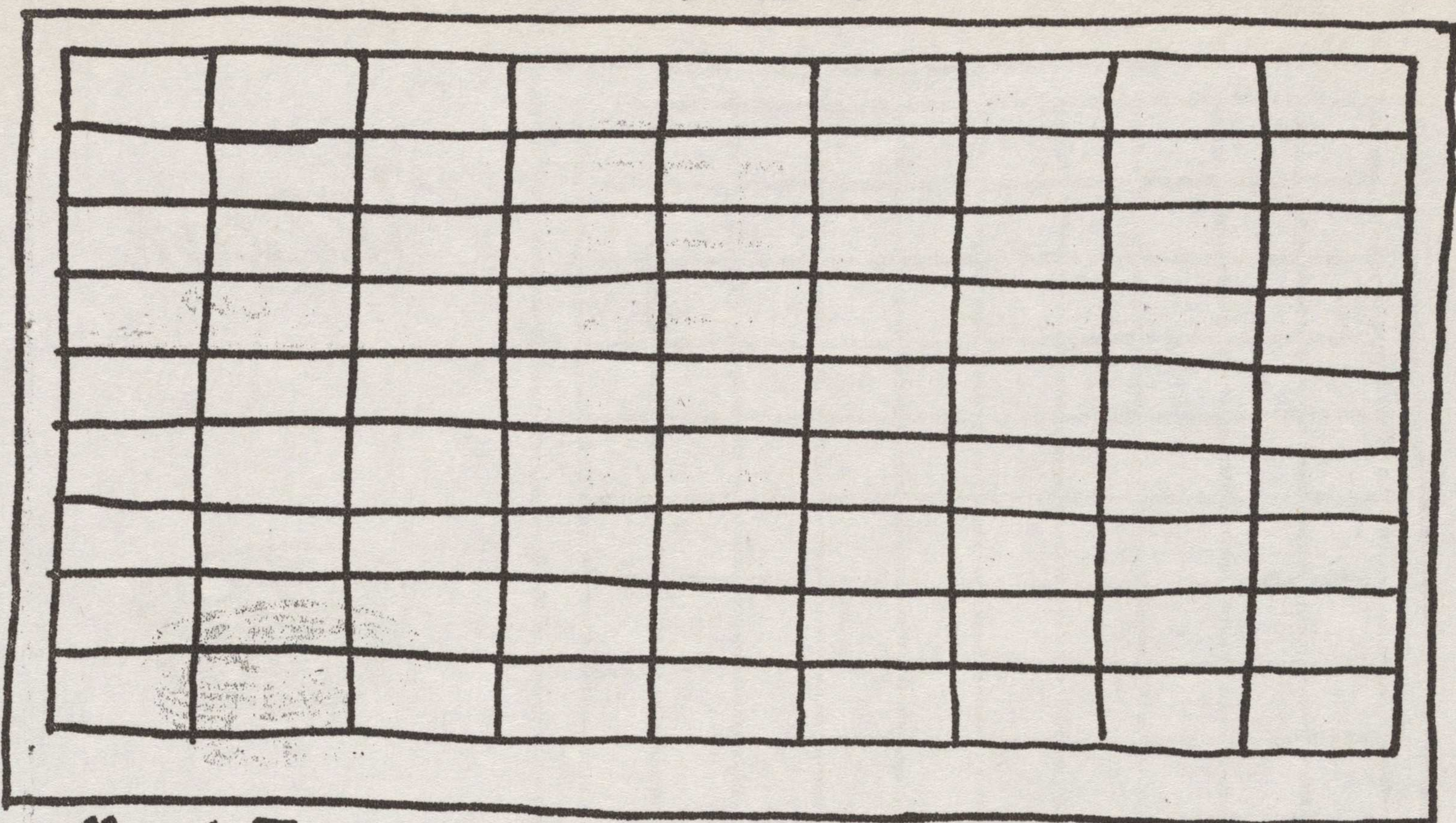


Chart I



$$2+2=$$

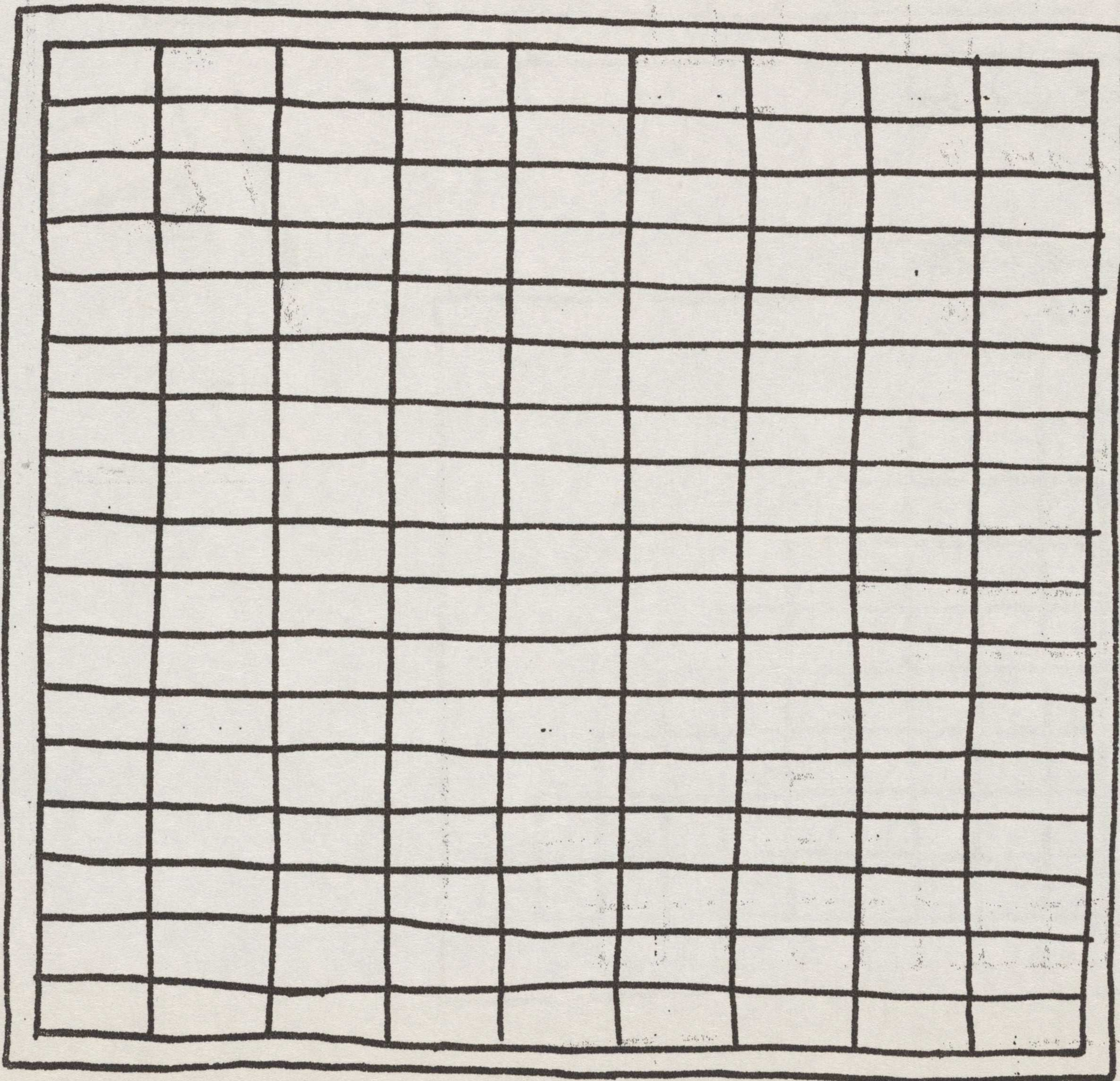


Chart II

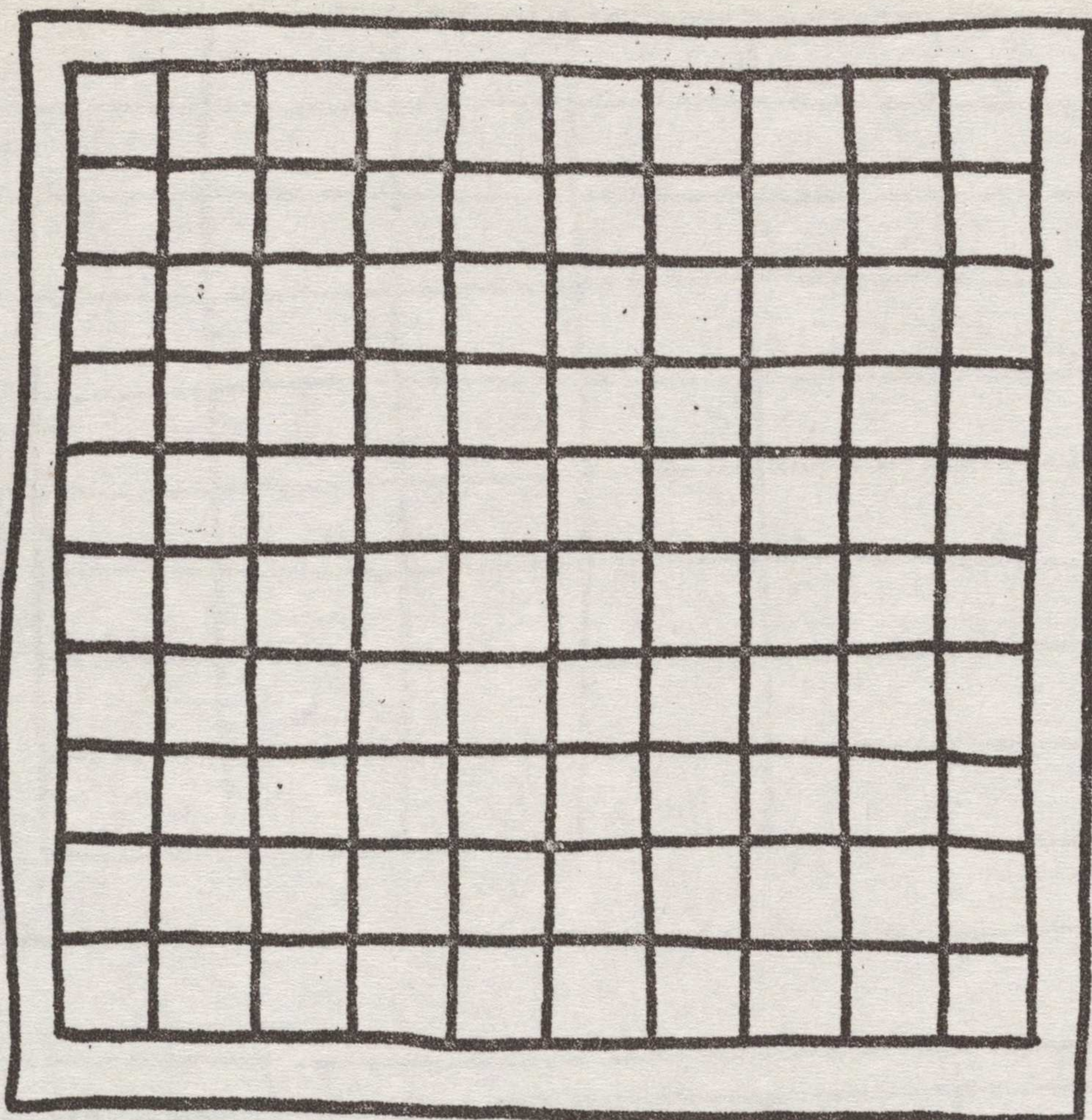
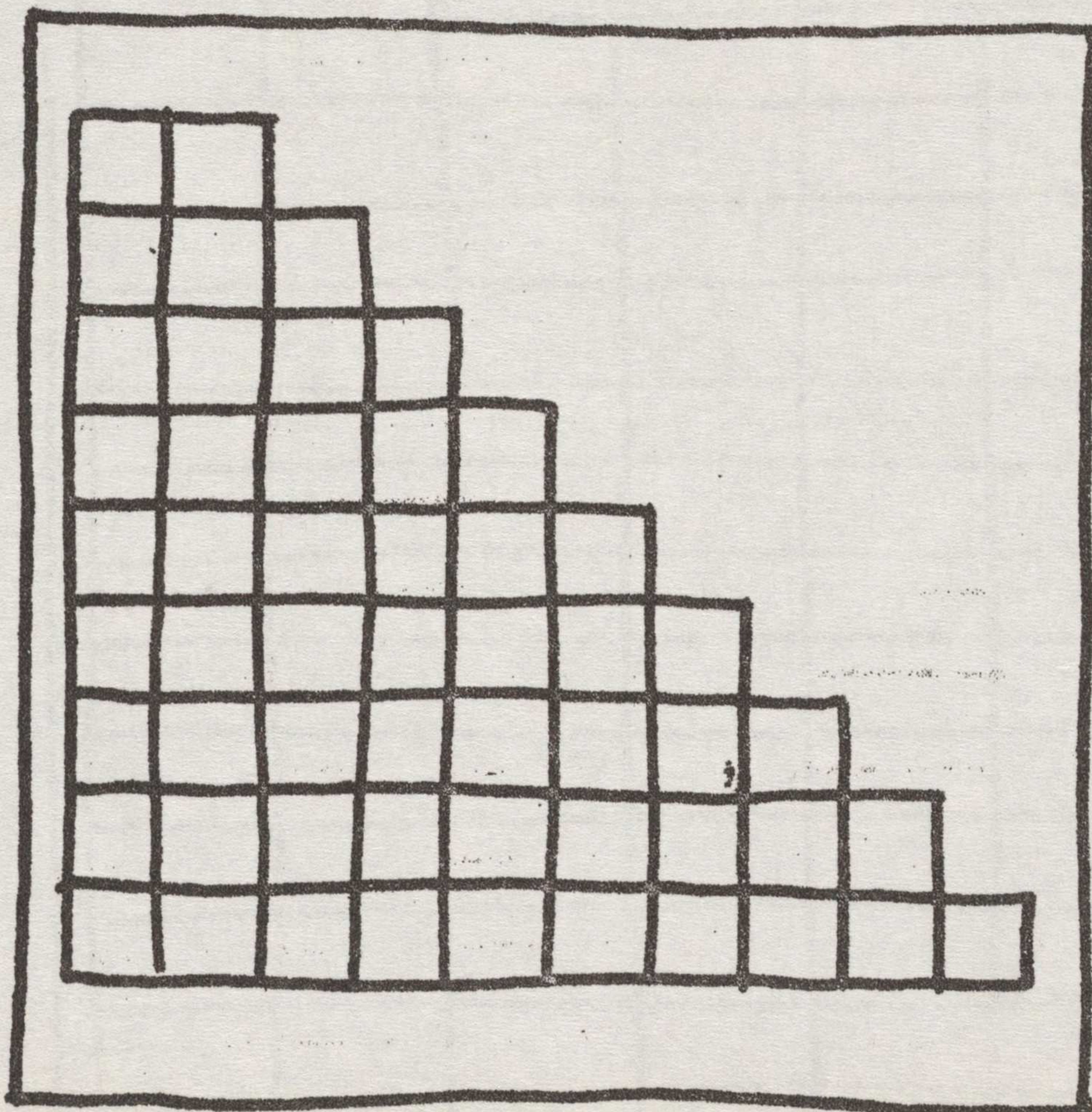


Chart III

Chart IV



Addition

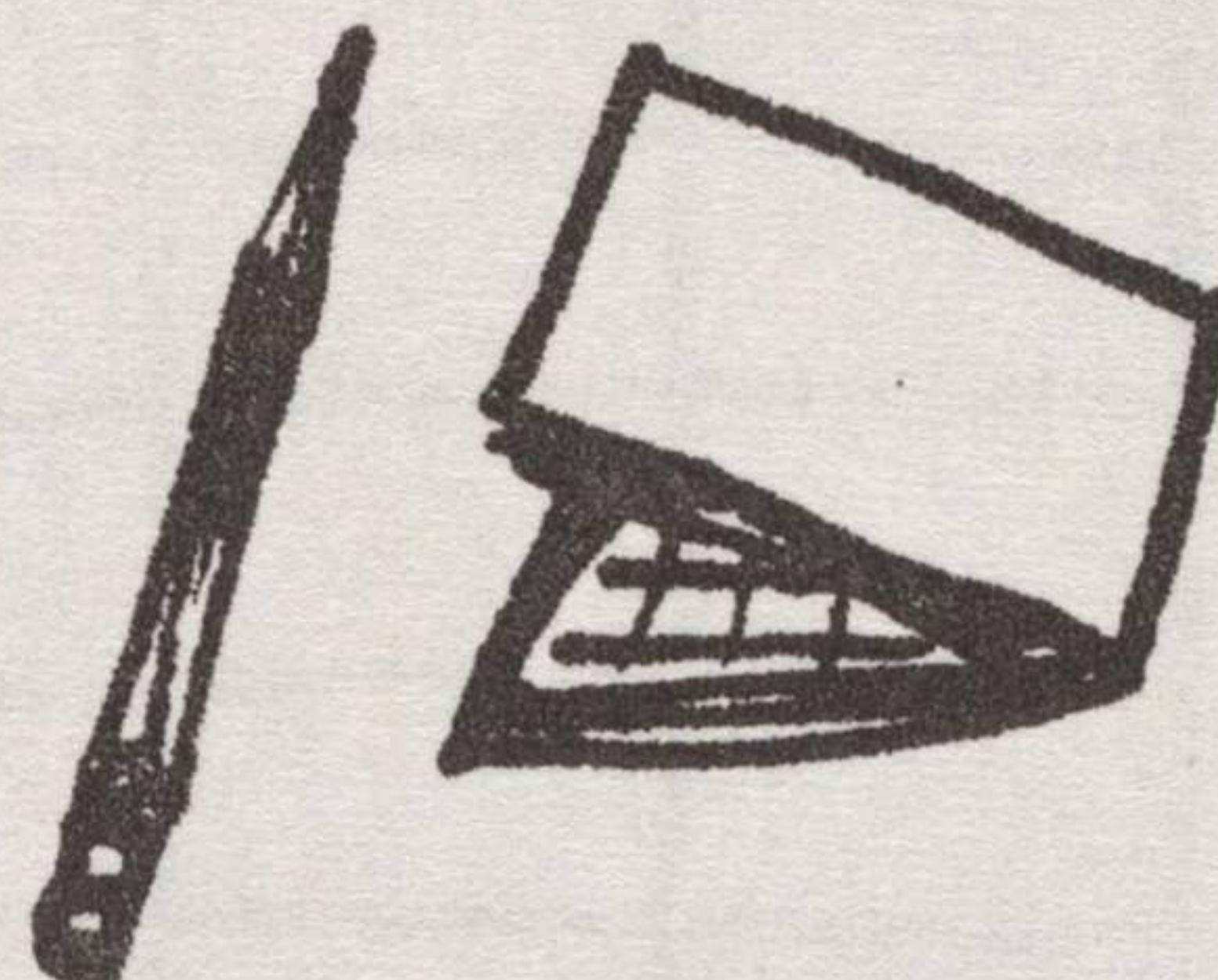


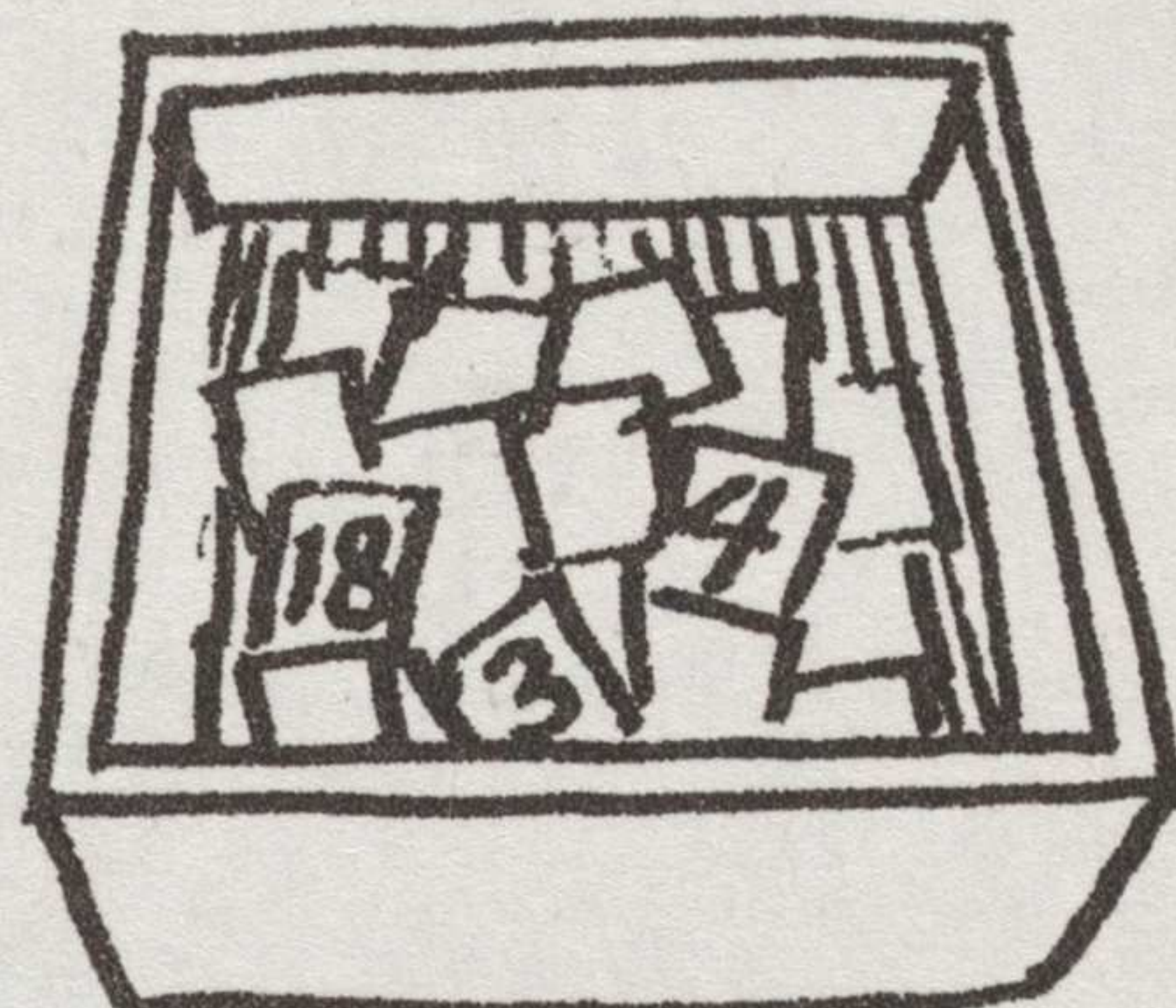
Chart V

1	2								
2	3	4							
3		5	6						
4			7	8					
5				9	10				
6					11	12			
7						13	14		
8							15	16	
9								17	18

0	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6									
7									
8									
9									

Blind Chart

Addition



Negative Snake Game

NEGATIVE SNAKE

MATERIAL

A number of colored short bead stairs in a wooden box.

One black and white bead stair.

A number of negative bead stairs that are composed of translucent blue beads representing the number 1 to 9. In every bar that contains more than five beads, a double link separates the fifth bead from the others.

A number of gold bead bars of 10 beads each.

A small notched card and two small trays.

DIRECT AIM

To further familiarize the child with the operation of subtraction in preparation for the subtraction tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Form long snake of colored bead bars, inserting a number of negative bars towards the end of the snake. No two negative bars should lie adjacent in the snake. The number of beads contained in the colored bars that precede a negative bar should be greater than the number of beads in the latter.
2. Count off ten beads using the notched card. Insert the card between the 10th and 11th beads.
3. Place a gold bead bar alongside the counted beads in the bead snake.
4. If necessary, count the remainder of beads in the partly-counted colored bead bar and place alongside this remainder a bar from the black and white bead stair that has the same number of beads as the remainder.
5. Remove the colored bead bars that have been counted, beginning with the last counted bar, and place them apart from the material at hand.
6. Count ten more beads beginning with the black and white bead bar, if there was a remainder or with the colored bead bar, if there was no remainder. Proceed as above.
7. Continue counting in the above described manner until a negative bead bar is reached. At this point note the number of beads in the negative bar and reverse the direction of the counting. Count back the same number of beads as are in the negative bar and insert the notched card after the last counted bead. Complete counting the number of beads in the partly counted bar. Then place a black and white bead bar of the same number of beads alongside this remainder.

NEGATIVE SNAKE GAME - CONTINUED

8. Remove from the snake the negative bar and the bar or bars that were counted in reverse. Put the negative bar on a tray, the colored bars on another tray and the gold bar - if any - back with the supply of gold bars.
9. Join the two parts of the snake and continue counting until all beads in the snake have been counted.
10. Arrange the colored bars that formed the snake into groups of like bars. Place the groups and the bars within each group, horizontally.
11. Arrange the gold bars and the black and white bar that were used in the snake game below the groups of colored bars leaving a space between each bar as it lies vertically to the groups.
12. Match every negative bar with a colored bar of the same number of beads.
13. Then match the gold bars with the remaining colored bars, making all exchanges necessary for a one-to-one matching. Place the colored bars alongside the gold bars.

NOTE: A one-to-one matching will only be possible if no mistakes were made in the counting.

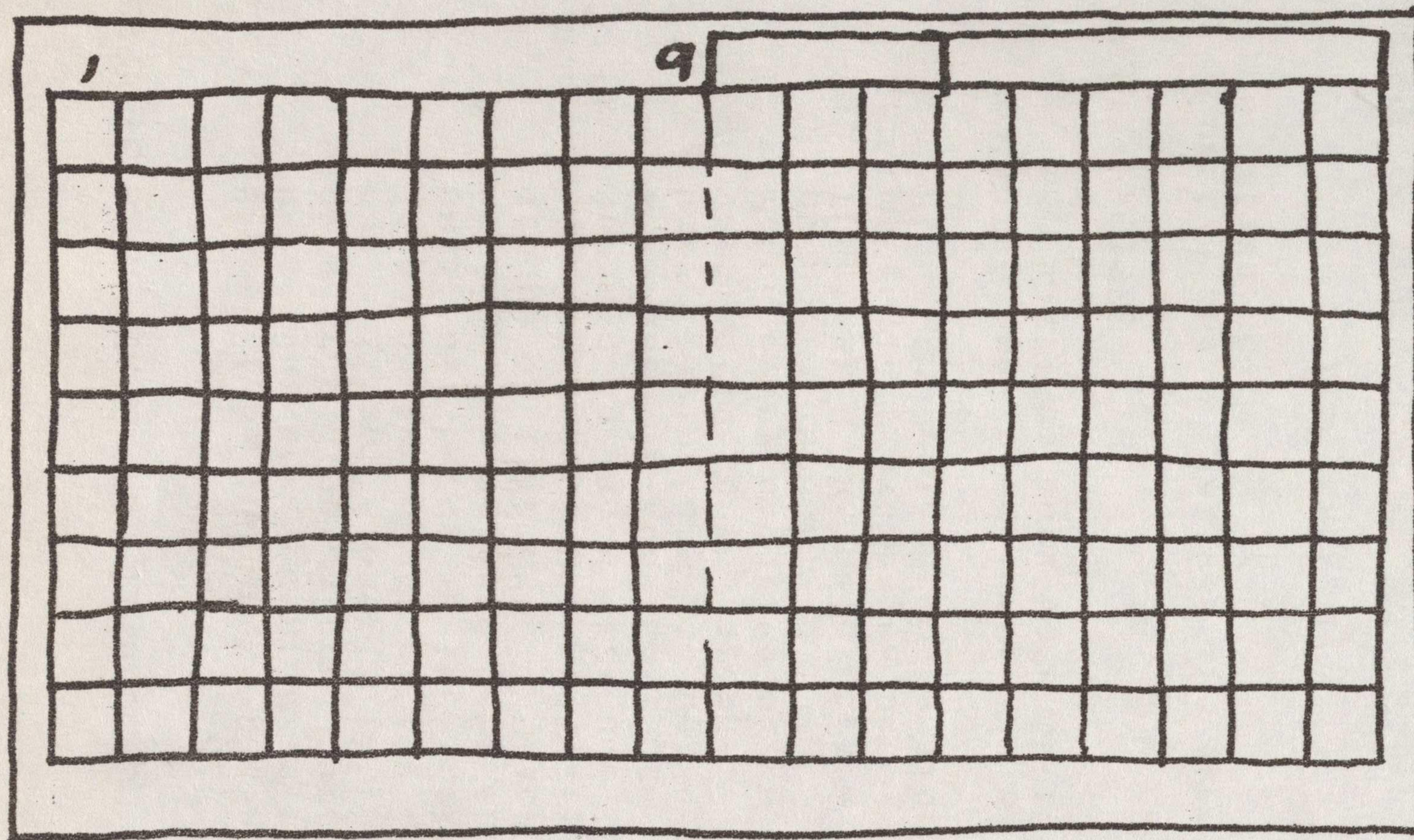
LATER EXERCISES

Count a snake that has the same number of positive and negative beads

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The final matching and the teacher.

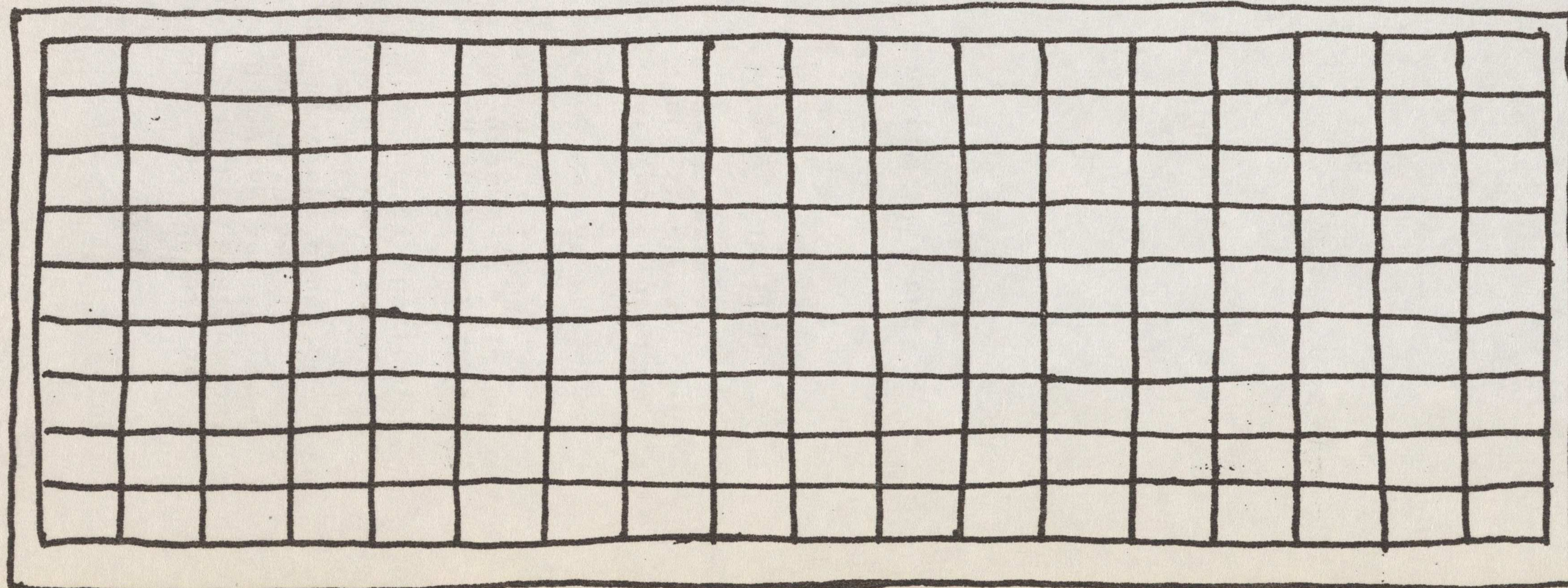


12	-1	=	11
12	-2	=	10
12	-3	=	
	-4	=	
	-5	=	
	-6	=	
	-7	=	
	-8	=	
	-9	=	



Negative Strip Board

Chart I



STRIP BOARD - SUBTRACTION

MATERIAL

Rectangular wooden board, with the numerals 1 to 9 printed in black and the numerals 10 to 18 printed in red across the top as columnar headings. The board is divided into 2 cm squares - 9 down and 18 across. Columns 9 and 10 are separated by a heavy line.

A set of blue wooden strips, 2cm wide and from 2cm to 18cm long. Each strip has one of the numerals 1 to 9 printed at the right end. The shortest strip has the numeral 1 and the longest the numeral 9 printed on it.

A set of red wooden strips, 2cm wide and from 2cm to 18cm long. Each strip is divided into 2cm squares and has one of the numerals 1 to 9 printed in the right end square. The shortest strip has the numeral 1 and the longest has the numeral 19.

A set of 18 blank unpainted wooden strips, 2cm wide and from 2cm to 36cm long.

A number of slips of paper each of which looks as follows:

-9=
-8=
-7=
-6=
-5=
-4=
-3=
-2=
-1=

Chart 1 is a subtraction table (see N. Newkirk illustration when completed).

DIRECT AIM

To construct the subtraction table.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Explain to the child that for the purpose of this exercise we are interested in results of 9 or less than 9.
2. Arrange the strips of each set in numeral sequence.
3. Choose the sum of 18. Place the blue strip marked with the numeral 9 so that it masks the numerals 10 through 18. Read the result at the left end of the blue strip.
4. Record the sum of 18 and the second addend nine on the slip of paper provided for this purpose. Remove the blue strip marked with the numeral 9.

STRIP BOARD - SUBTRACTION - CONTINUED

5. Show that when the blue strip marked with the numeral eight is used, the result would be greater than nine. Hence, it should not be used at this point.
6. Mask the numeral 18 with the smallest blank tablet.
7. Place the blue strip marked with the numeral 9 so that it masks the numerals 9 through 17. Read the result at the left end of the blue strip.
8. Record the sum 17 and the second addend 8 on another slip of paper provided for this purpose. Remove the blue strip marked with the numeral 9.
9. Place the blue strip marked with the numeral 8 so that it masks the numerals 10 through 17. Read the result at the left end of the blue strip.
10. Record the sum 17 and the second addend 9 on the slip of paper just used.
11. Continue to ask the numeral headings that do not apply at the time, and use the blue strips as described above.
12. Check the recorded results (second addends) against chart 1.

LATER EXERCISES

Select any sum between 1 and 18, inclusively, and mask the numerals to the right of this sum. Assume, for example, that the sum is 6.

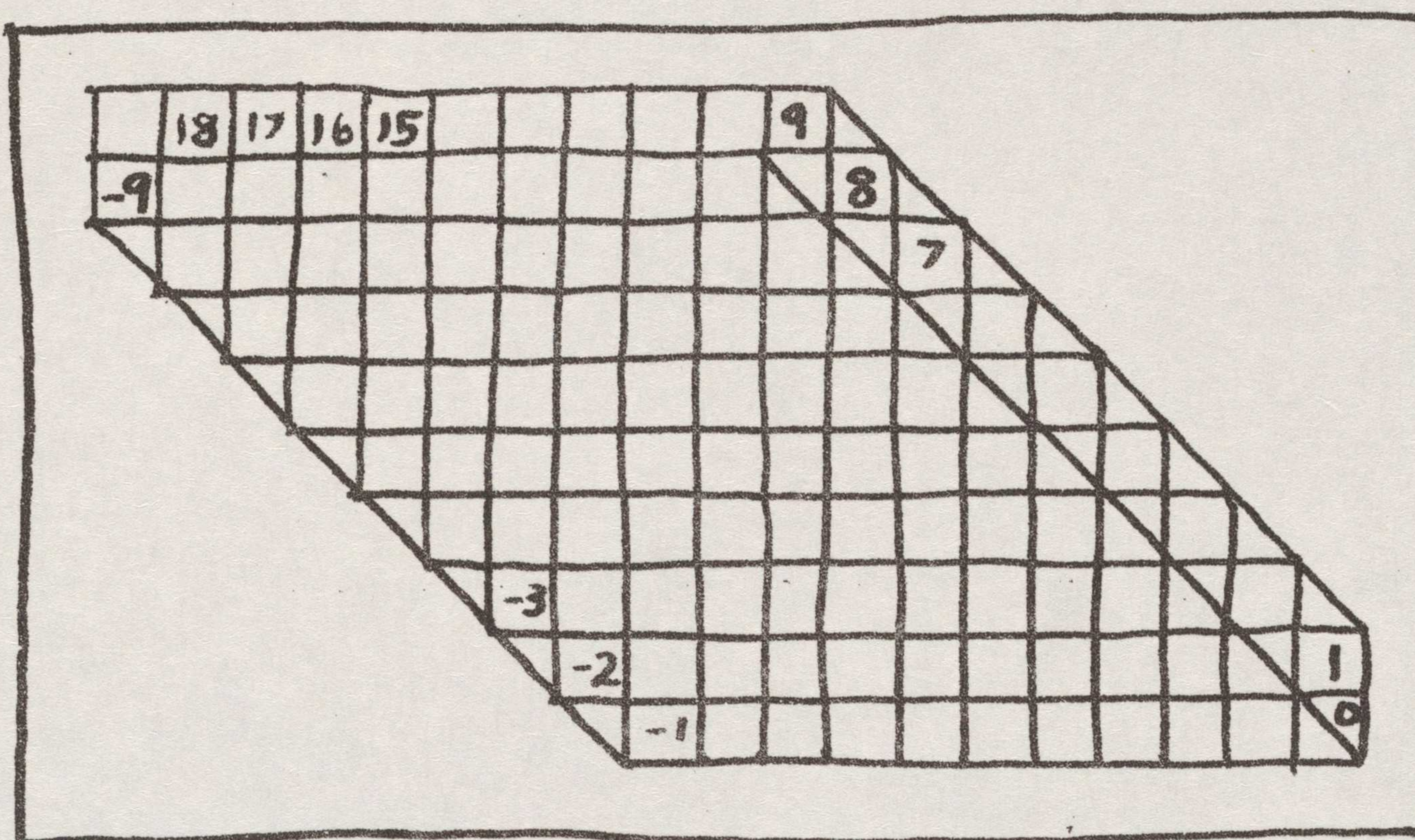
- a) Place a red strip marked with the numeral 5 on the board so that it masks the first five squares of the first row. Ask the child what number must be added to 5 in order to make 6. Then place the blue strip marked with the numeral 1 on the sixth square of the first row.
- b) Place the red strip marked with the numeral 4 on the board so that it masks the first four squares of the second row. Ask the child what number must be added to 4 in order to make 6. Then place the blue strip marked with the numeral 2 on the fifth and sixth squares of the second row. Continue this process to the fifth row.
- c) Remove the blue strip marked with the numeral 1 from the board enunciating, "the difference between 6 and 5 is 1". Record the equation.
- d) Remove the blue strip marked with the numeral 2 from the board, enunciating, "the difference between 6 and 4 is 2". Record the equation. Continue in this manner until all blue strips have been removed from the board. Check the recordings against chart 1.

AGE 5 to 6-1/2 years.

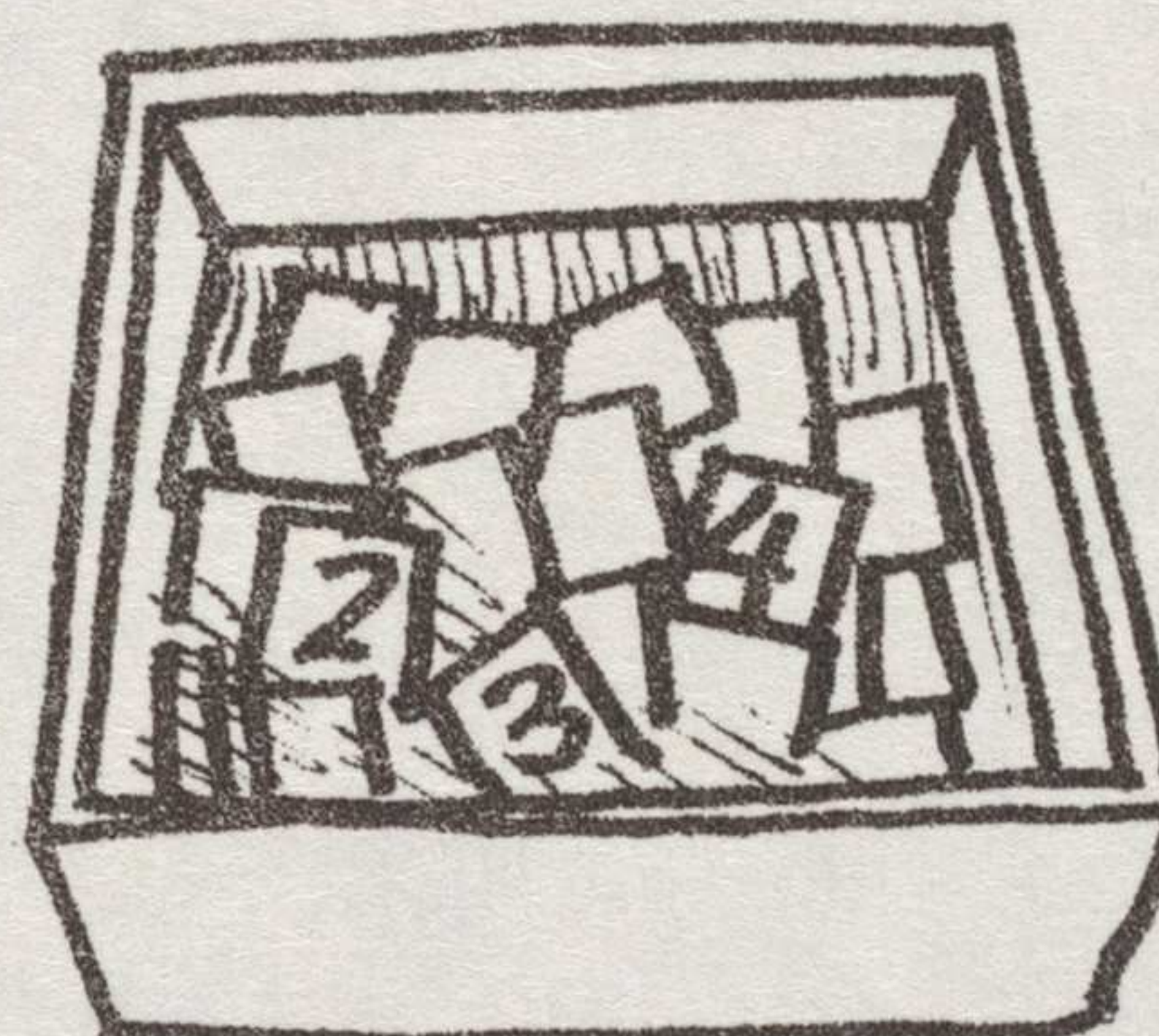
CONTROL OF ERROR

The teacher and Chart 1.

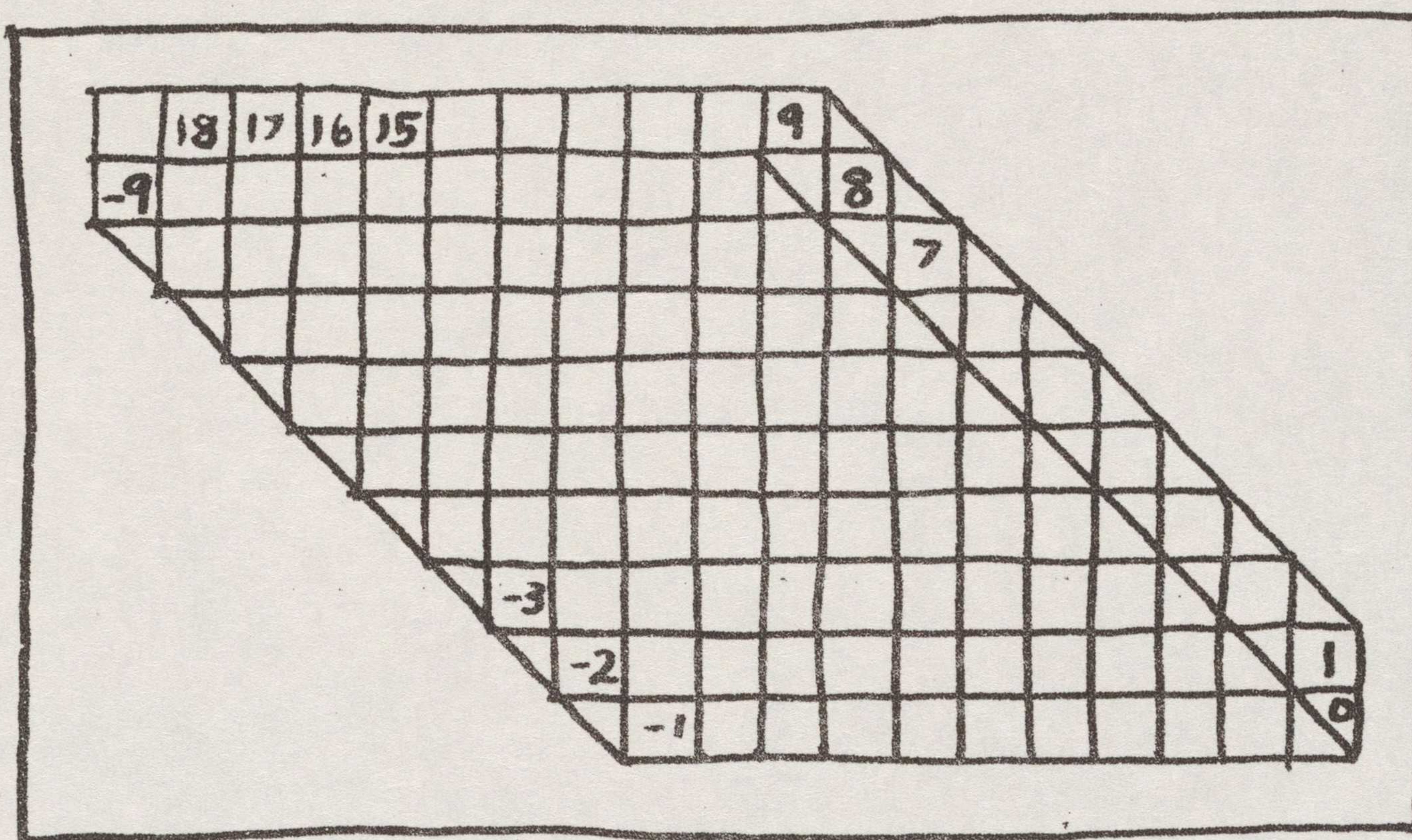
Subtraction



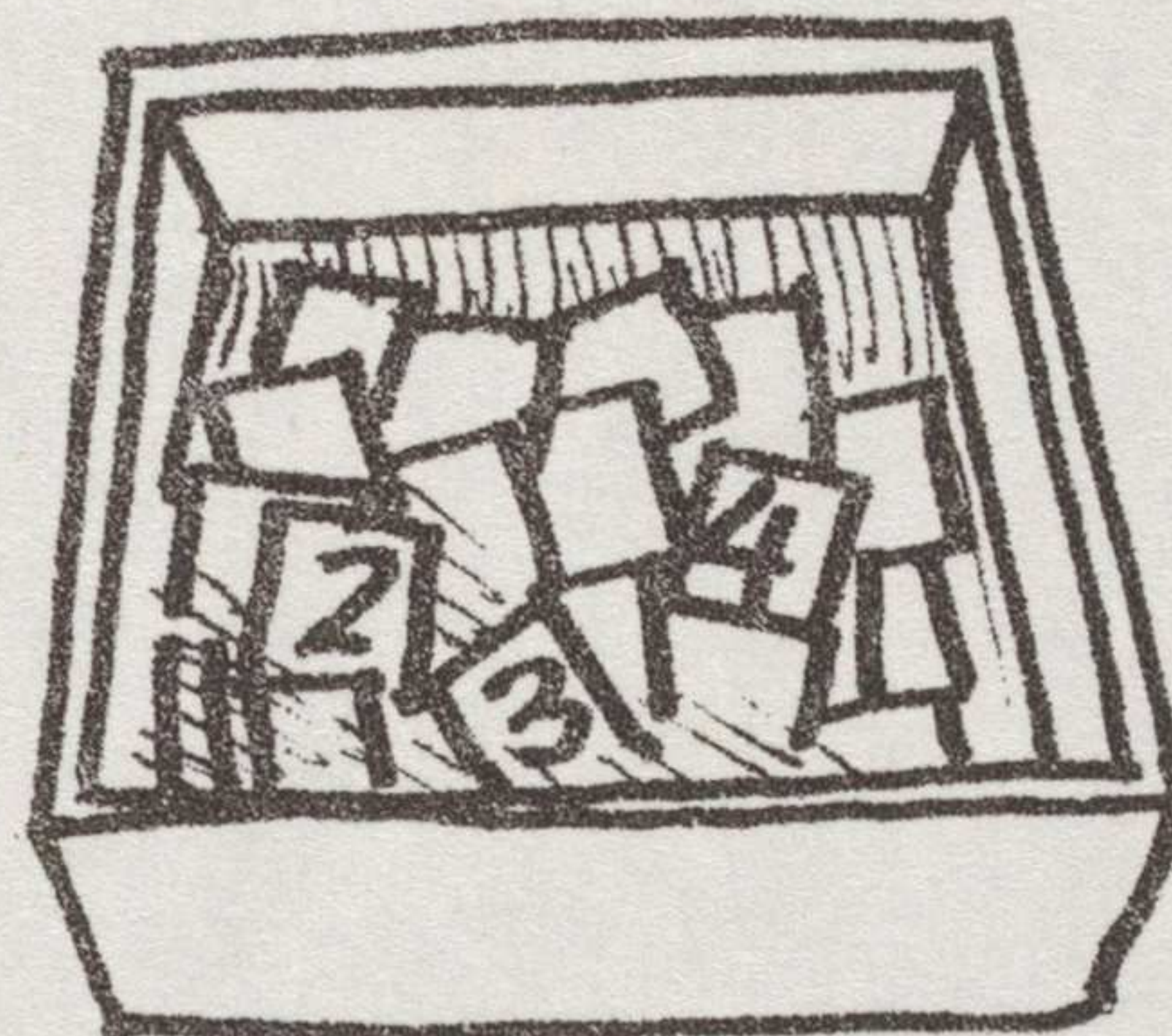
Blind Chart



Subtraction



Blind Chart



CHARTS - SUBTRACTION

MATERIAL

Two subtraction tables and one blind chart as illustrated by Newkirk and in attachment. Throughout this exercise these will be referred to as chart 1 or 2; the blind chart will be referred to by this name.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of chart 2. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written the same combinations of sum and first addend as appear on the partially completed chart 1 illustrated by Newkirk. Sum and first addend are separated by a minus sign and equal sign follows the addend. The second addend is not given. There is one slip of paper for every pair of numbers.

Pencils and square-ruled paper.

DIRECT AIM

To use various forms of subtraction tables in order to have the child memorize the results of the subtraction operations that are contained in these tables.

INDIRECT AIM

To develop mathematical understanding.

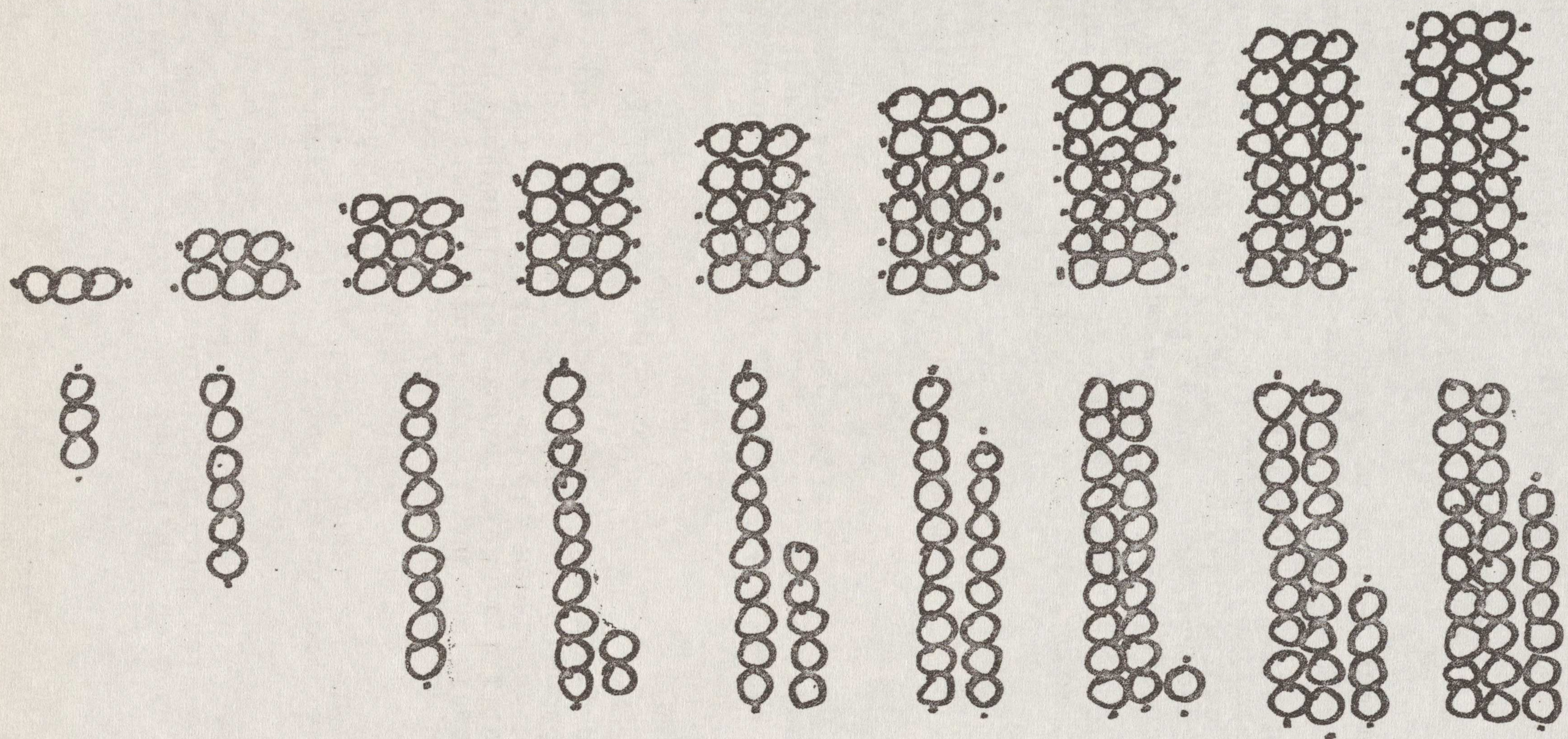
PRESENTATION

1. Have the child pick a slip of paper from the basket and copy what is written on it onto a sheet of square-ruled paper.
2. He finds the second addend on chart 2, recording it after the equal sign on his paper. The unknown addend is located at the intersection of the column numbered by the sum with the row numbered by the first addend.
3. The child continues in this manner until he tires of the exercise.
4. Then he checks the results written on his paper by comparing them with those on chart 1 and makes any necessary corrections.

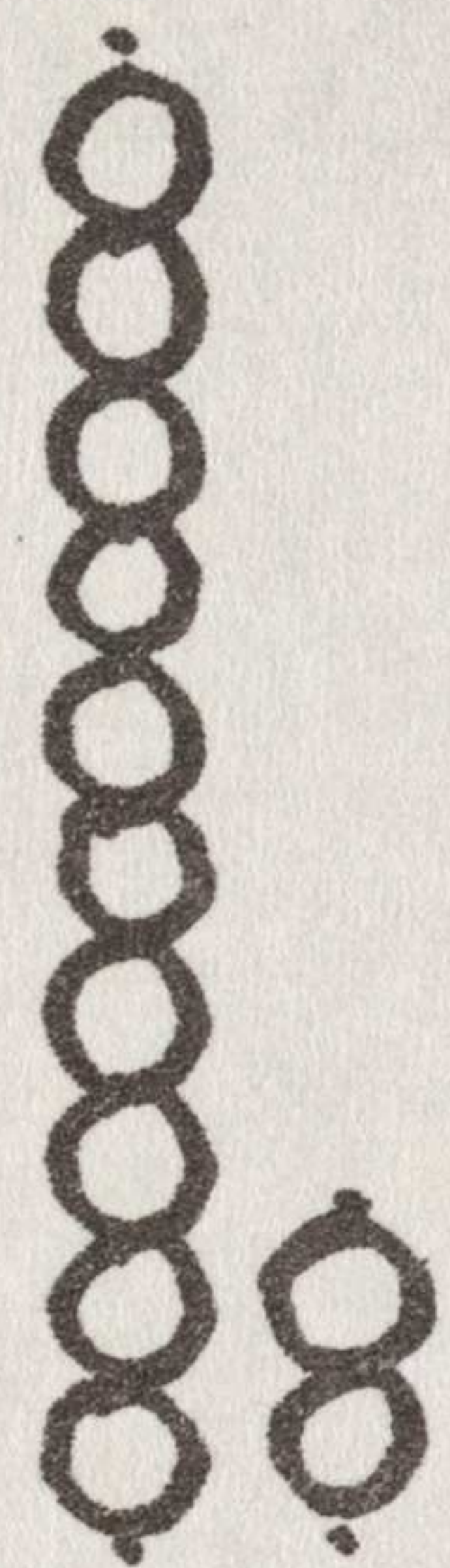
LATER EXERCISES

Use the basket in conjunction with the blind chart and chart 2 as follows:

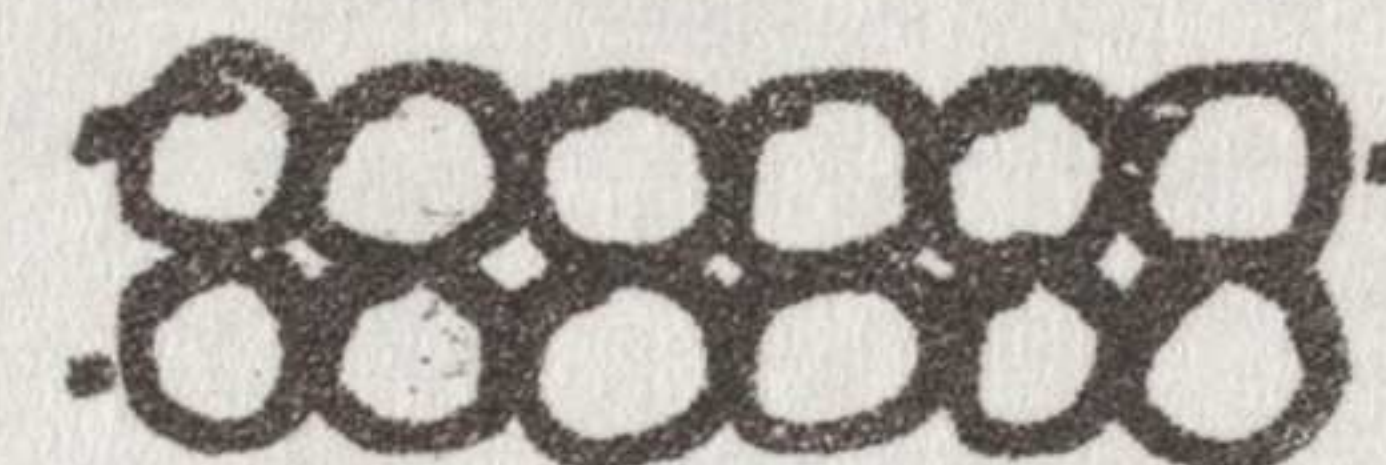
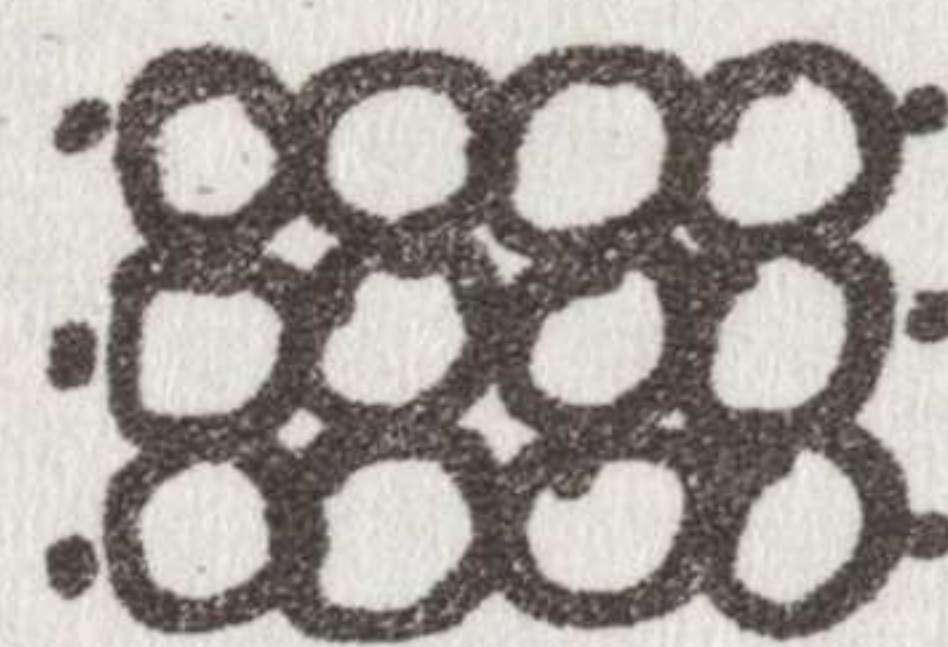
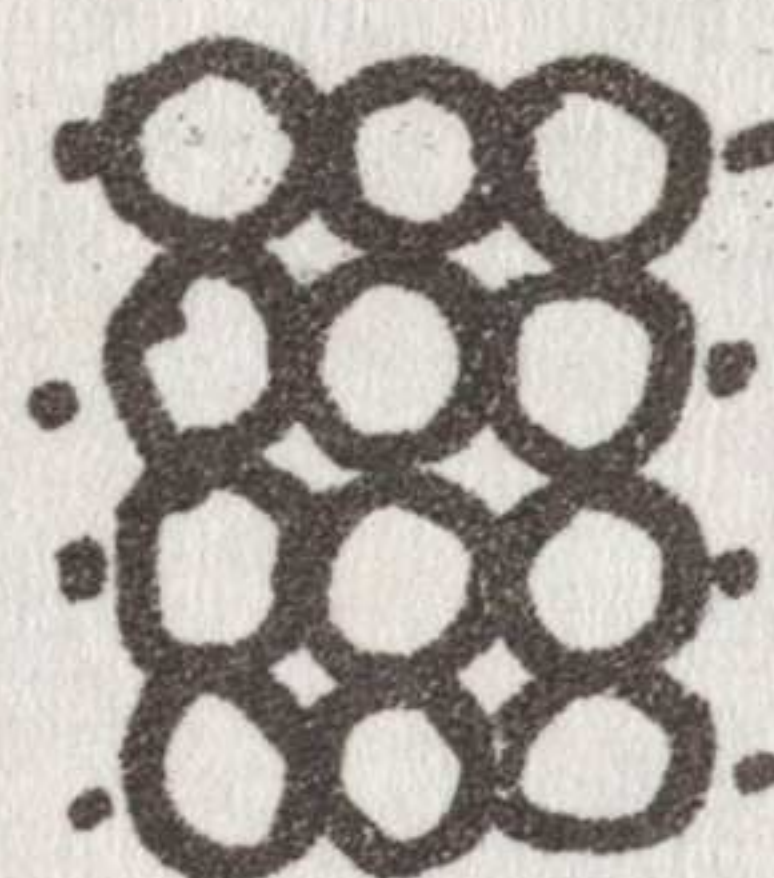
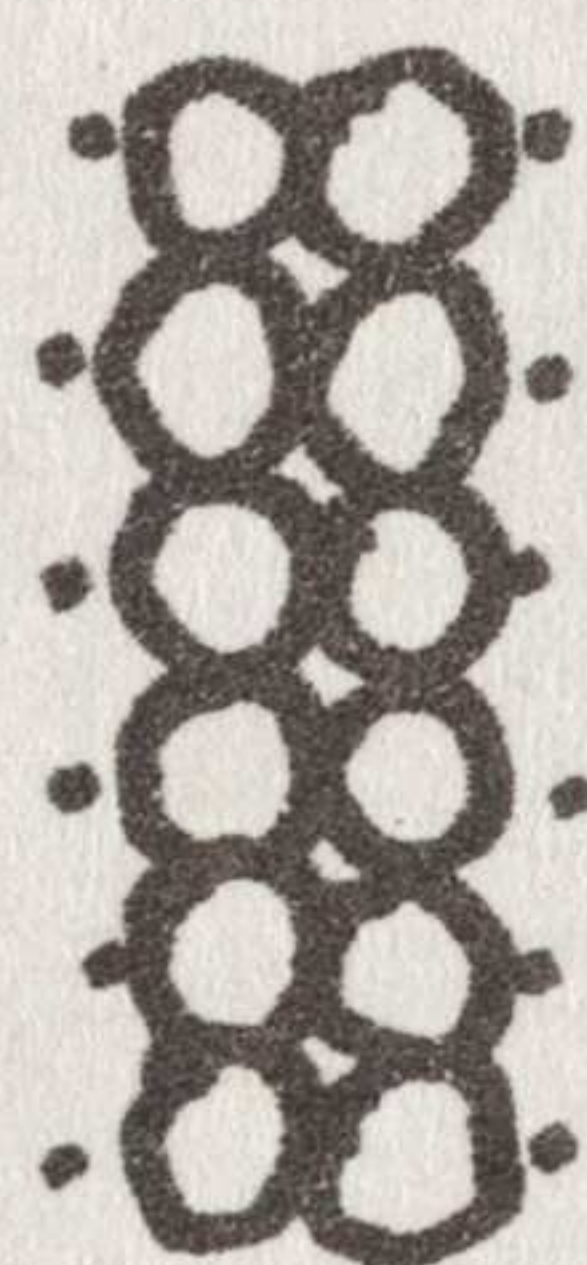
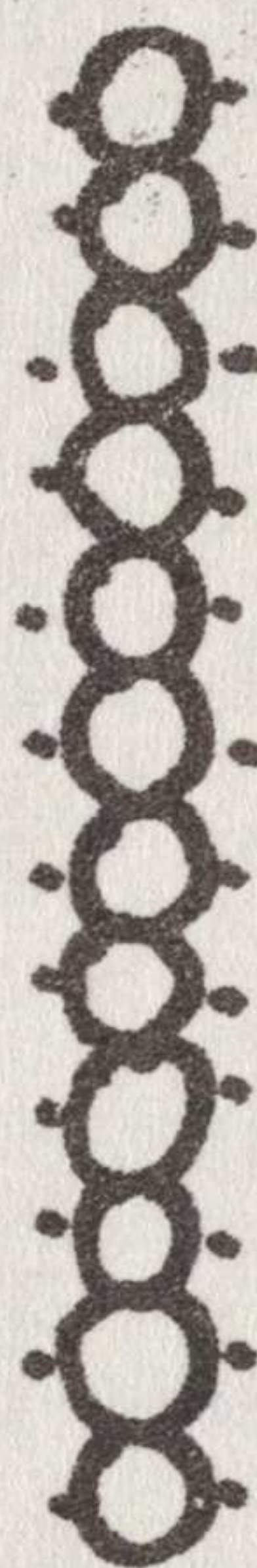
- a) child picks a slip of paper from the basket;
- b) mentally solves for the unknown addend;
- c) places the tablet that describes this addend into the appropriate square on the blind chart;
- d) after doing many examples the child checks for correctness of results with chart 2.

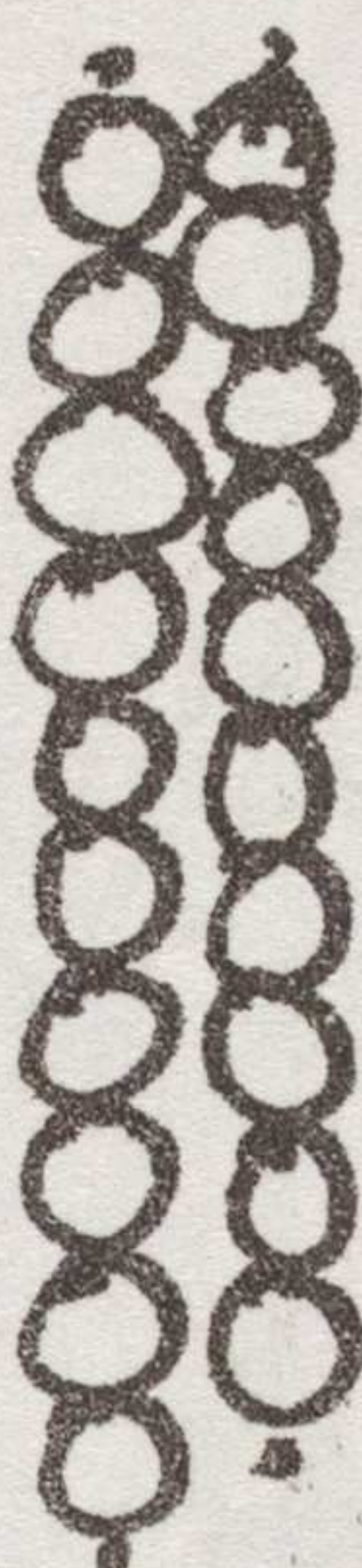
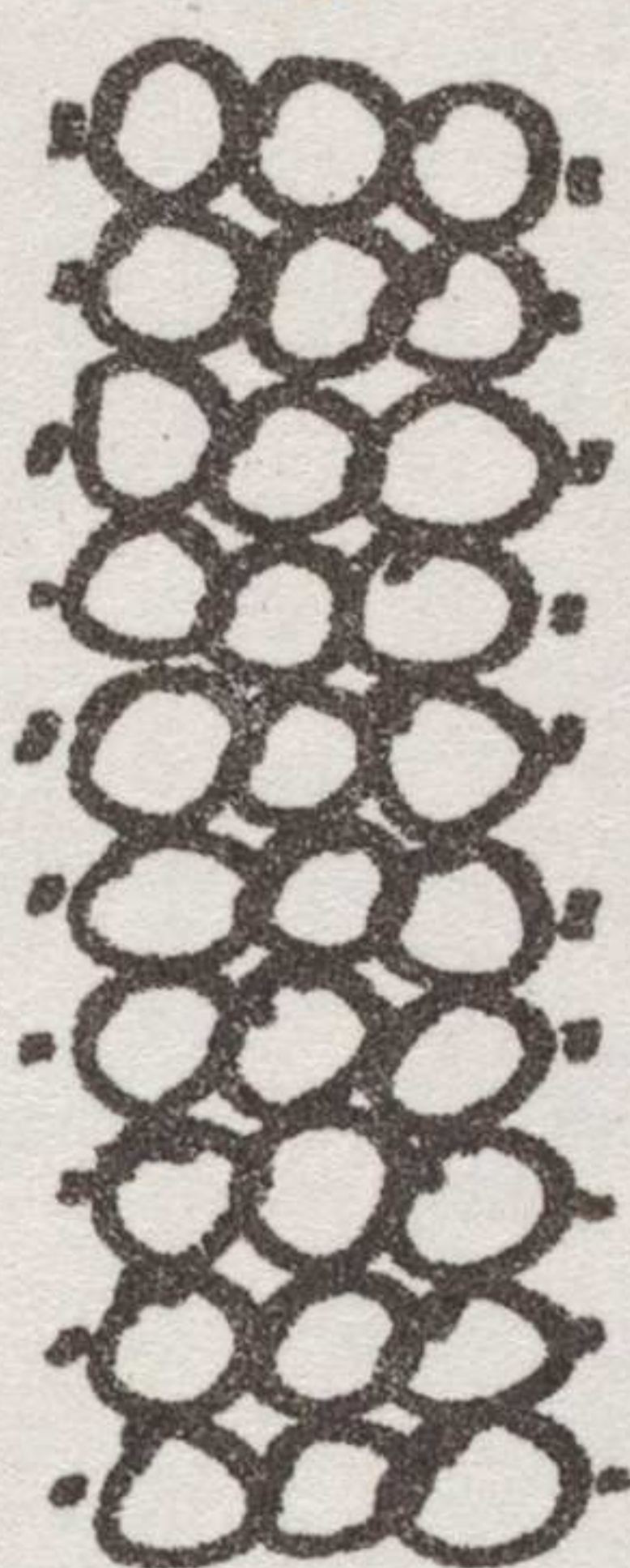
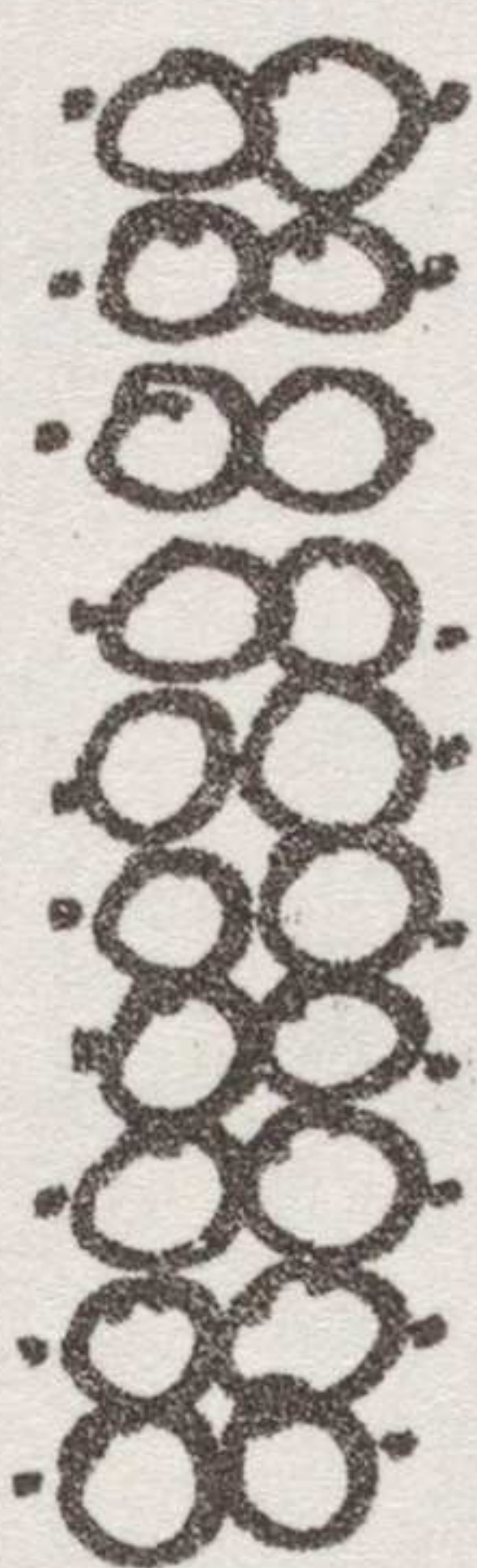


Construction of a Multiplication Table



Many Ways of Making a Number





Take Ten Times a Number

MULTIPLICATION WITH BEAD BARS

MATERIAL

55 colored bead stairs. 55 gold bead bars of 10 beads each.
10 black and white bead stairs. 10 different colored bead
squares. Slips of paper and pencils.

DIRECT AIM

To construct multiplication tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Let the child choose the table to be constructed. Assume, for the purposes of demonstration, that he chooses 6.
2. Take one bar of 6 beads and place it horizontally.
3. Below and vertical to it place a black and white bar of six beads.
4. Now take two bars of 6 beads each and place them horizontally one below the other and to the right of the first bar. Below these two bars, represent the quantity 12 by using one gold bead bar and the black bar of 2 beads. Place these two bars vertically to the two 6-bars.
5. Continue in this manner until 10 bars of 6 beads each, have been placed and every quantity has been represented by the appropriate combination of gold and black and white bead bars.
6. Superimpose the bead square of 6 on the 6 rows of 6 bars. Enunciate that 6 taken 6 times forms the square of 6.

LATER EXERCISES

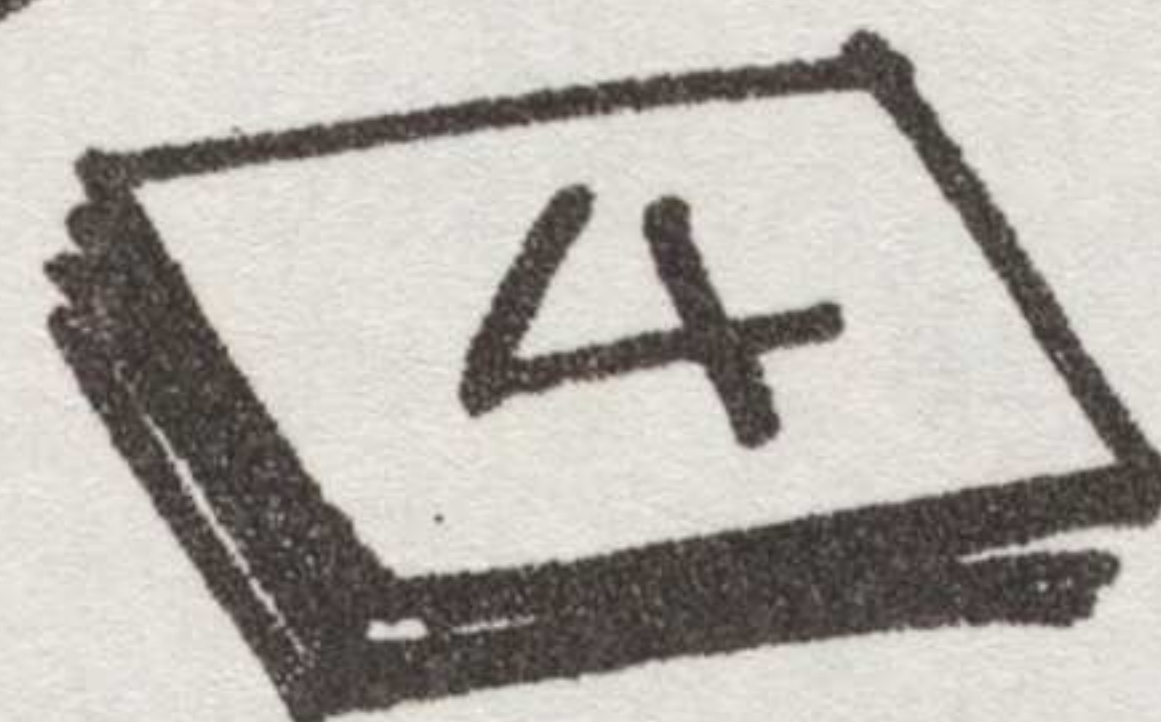
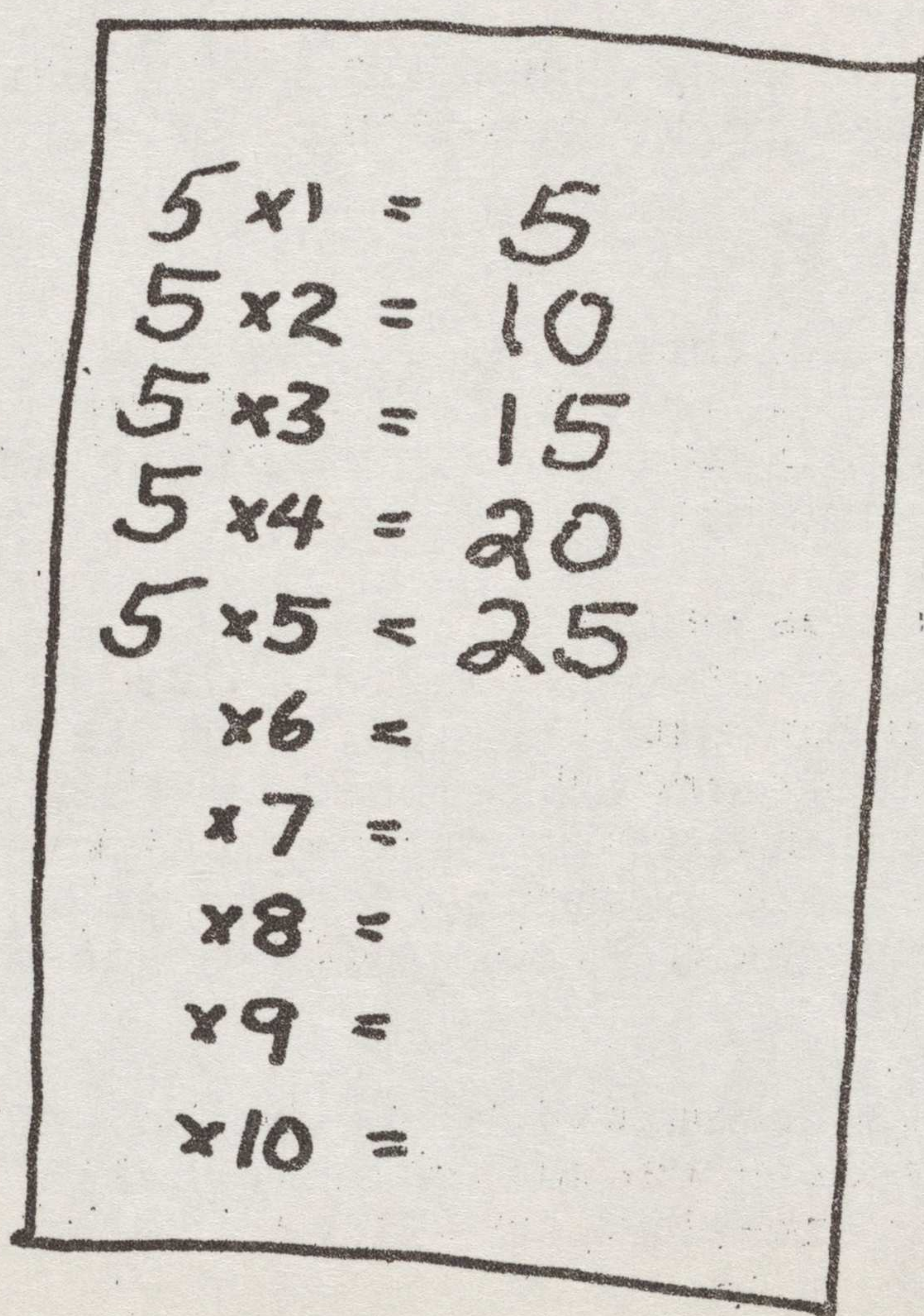
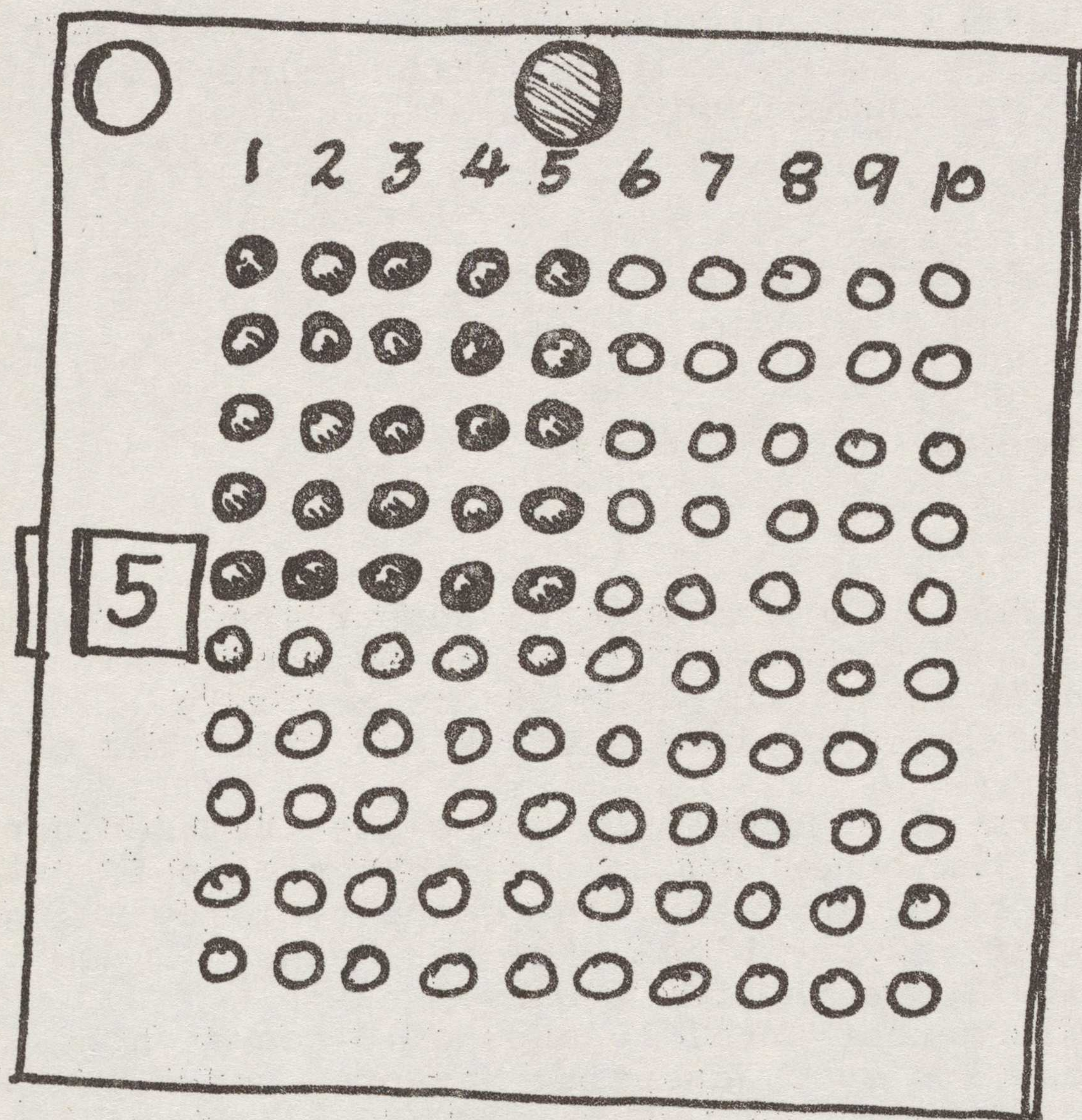
1. Construct arrays of 10 twos, 10 threes,, 10 tens. Form the respective totals below the arrays, in the manner described above. As each total is formed, record it as follows, taking 20 for an example:
 - a) Record the numeral 2;
 - b) Enunciate "2 taken 10 times makes 20";
 - c) Add the 0 to the numeral 2 as you enunciate 20.
2. Select any product less than or equal to 100, e.g. 12. Form this quantity in gold and black and white beads. Form this product in as many combinations of factors as possible using the colored bead bars. For example, 6 bars of 2 beads each, 4 bars of 3 beads each, 3 bars of 4 beads each, and 2 bars of 6 beads each.
3. Show that multiplication is a commutative operation. For example, superimpose 2 bars of 6 beads each on 6 bars of 2 beads each to show they are the same size.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The teacher.

Multiplication Board



MULTIPLICATION BOARD**MATERIAL**

A wooden board with 100 holes arranged in the form of a square. The ten columns of holes are numbered 1 through 10. On the left side of the board is a slot for insertion of a numeral card. In the top left corner is a circular groove that holds a removable disk.

10 small cards on which are printed the numerals 1 through 10.

A jar that contains 100 light blue beads.

Multiplication chart 1 as illustrated in the attachment.

A number of slips of paper each of which looks as follows:

x 1=
x 2=
x 3=
x 4=
x 5=
x 6=
x 7=
x 8=
x 9=
x 10=

DIRECT AIM

To construct multiplication tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Let the child choose the table to be constructed. Assume, for purposes of demonstration, that he chooses 5.
2. Insert the card marked with the numeral 5 into the slot on the board and place the disk above the numeral 1.
3. Put 5 beads (or ones) into the first column of holes, starting from the top of the board.
4. Record the factor 5 and the product 5 on the prepared slip of paper. As you do so, enunciate "5 times 1 equals 5".
5. Move the disk above the numeral 2 on the board. Put 5 beads into the second column of holes, starting from the top of the board.
6. Record the factor 5 and the product 10 on the same slip of paper. As you do so, enunciate "5 times 2 equals 10".
7. Continue as before until there are five rows of 10 beads each. Record as before.
8. Check the recordings against the multiplication chart 1.

LATER EXERCISES

Construct all the tables 1 through 10 in the manner described above.

AGE 5 to 6-1/2 years

CONTROL OF ERROR Chart 1 and the teacher.



$$2 \times 4 =$$

Multiplication

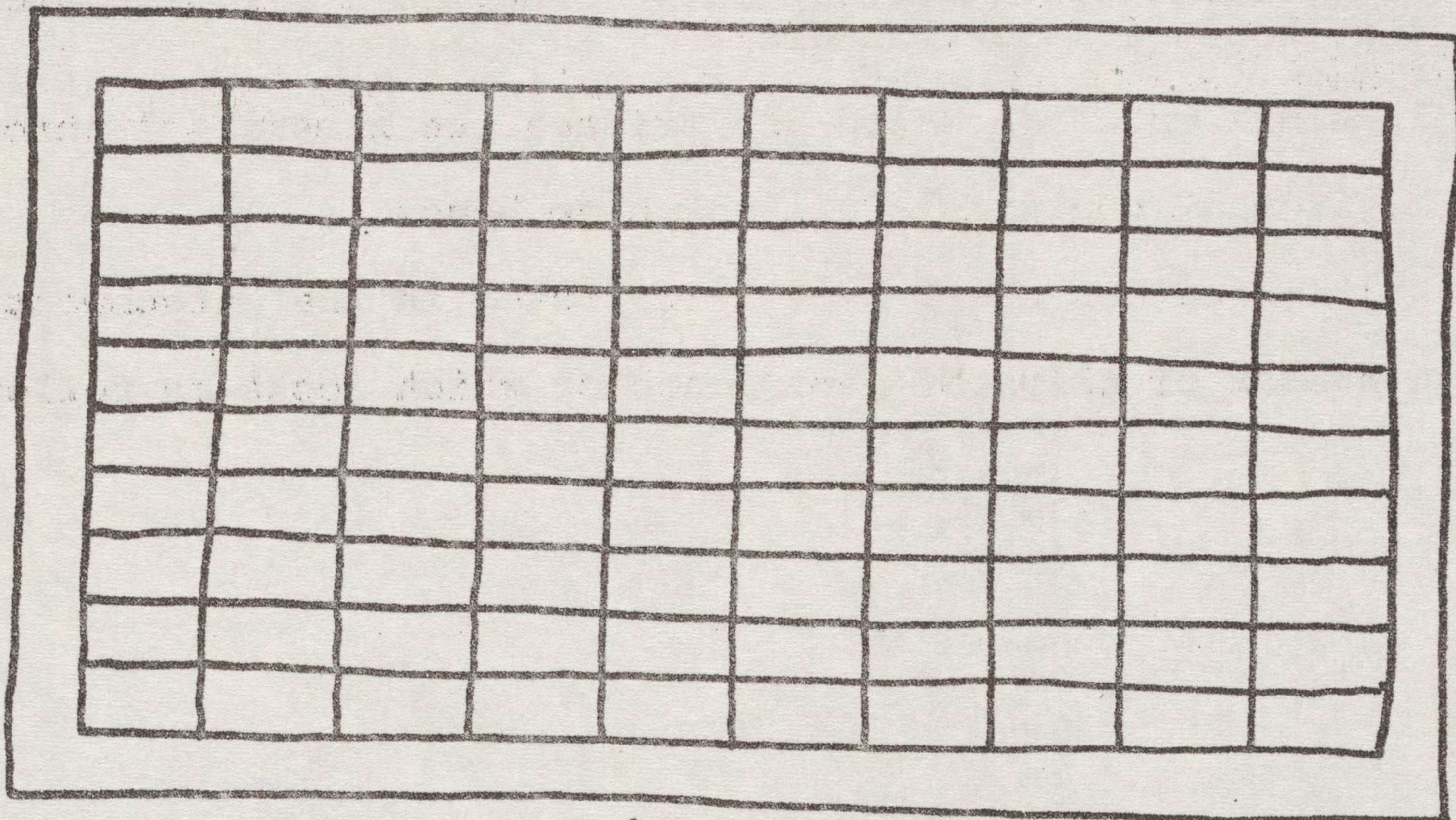


Chart I

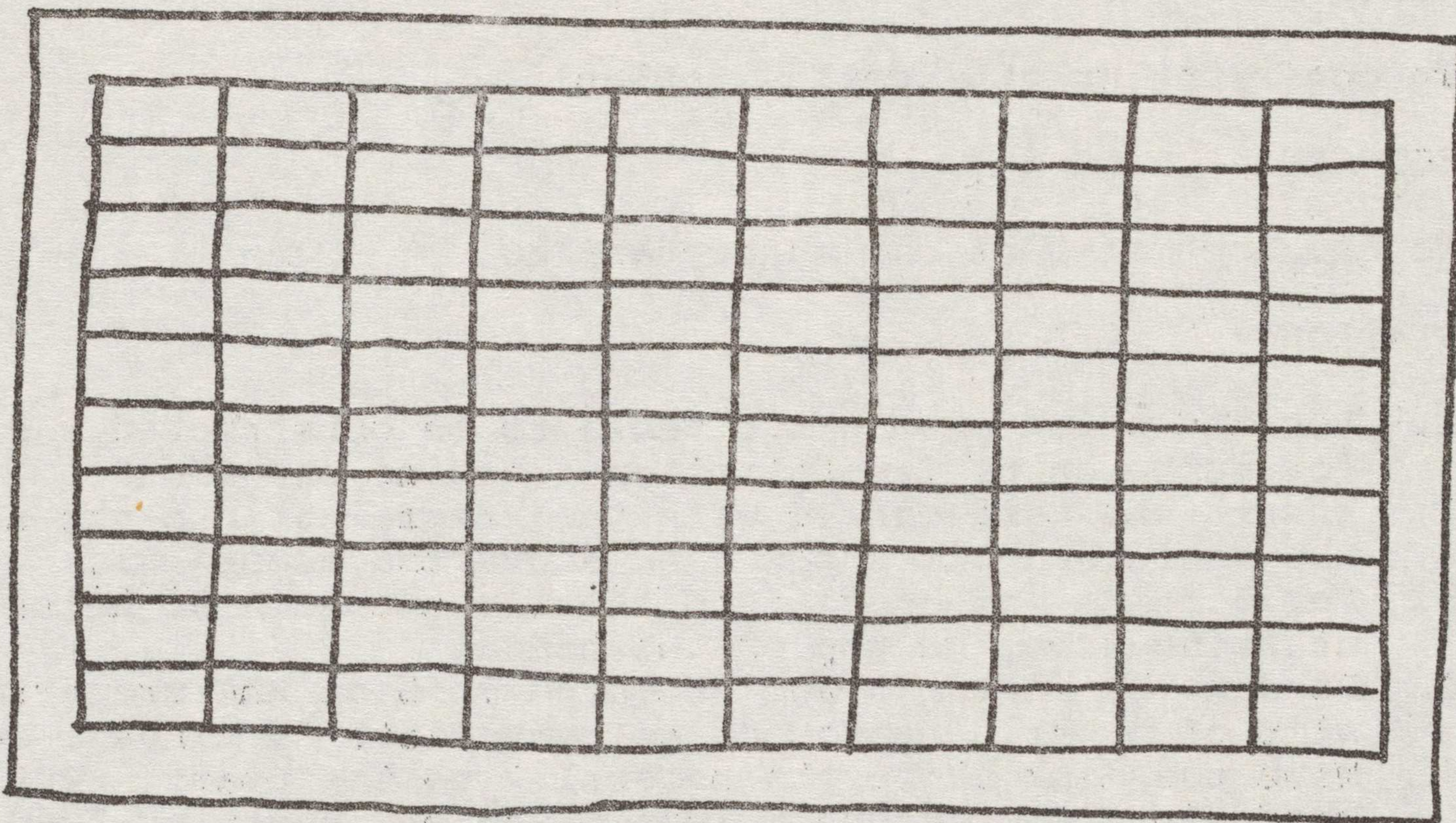


Chart II

CHARTS - MULTIPLICATION

MATERIAL

Three multiplication tables and one blind chart as illustrated in the attachment. Throughout this exercise these will be referred to as chart 3 or 4. The blind chart will be referred to by this name. Chart 1 as referred to in the previous exercise, will serve as a control device.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of chart 3. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written all possible permutations, taken two at a time of the numbers 1 to 9, with a multiplication sign between any two numbers and an equal sign after the second factor. The products are not given. There is one slip of paper for each permutation.

A second basket containing folded slips of paper on which are written all possible combinations, taken two at a time, of the numbers 1 to 9, with an equal sign after the second factor. The products are not given. There is one slip of paper for each combination.

Pencils and square-ruled paper.

DIRECT AIM

To use various forms of multiplication tables in order to have the child memorize the results of the multiplication operations that are contained in these tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Have the child pick a slip of paper from the first basket and copy what is written on it on a sheet of square-ruled paper.
2. He finds the product on chart 3, recording it after the equal sign on his paper. The result of the multiplication is located at the intersection of the column numbered by the first factor with the row numbered by the second factor.
3. The child continues in this manner until he tires of the exercise.
4. Then he checks the results written on his paper by comparing them with those on chart 1, and makes any necessary corrections.

Multiplication

Chart III

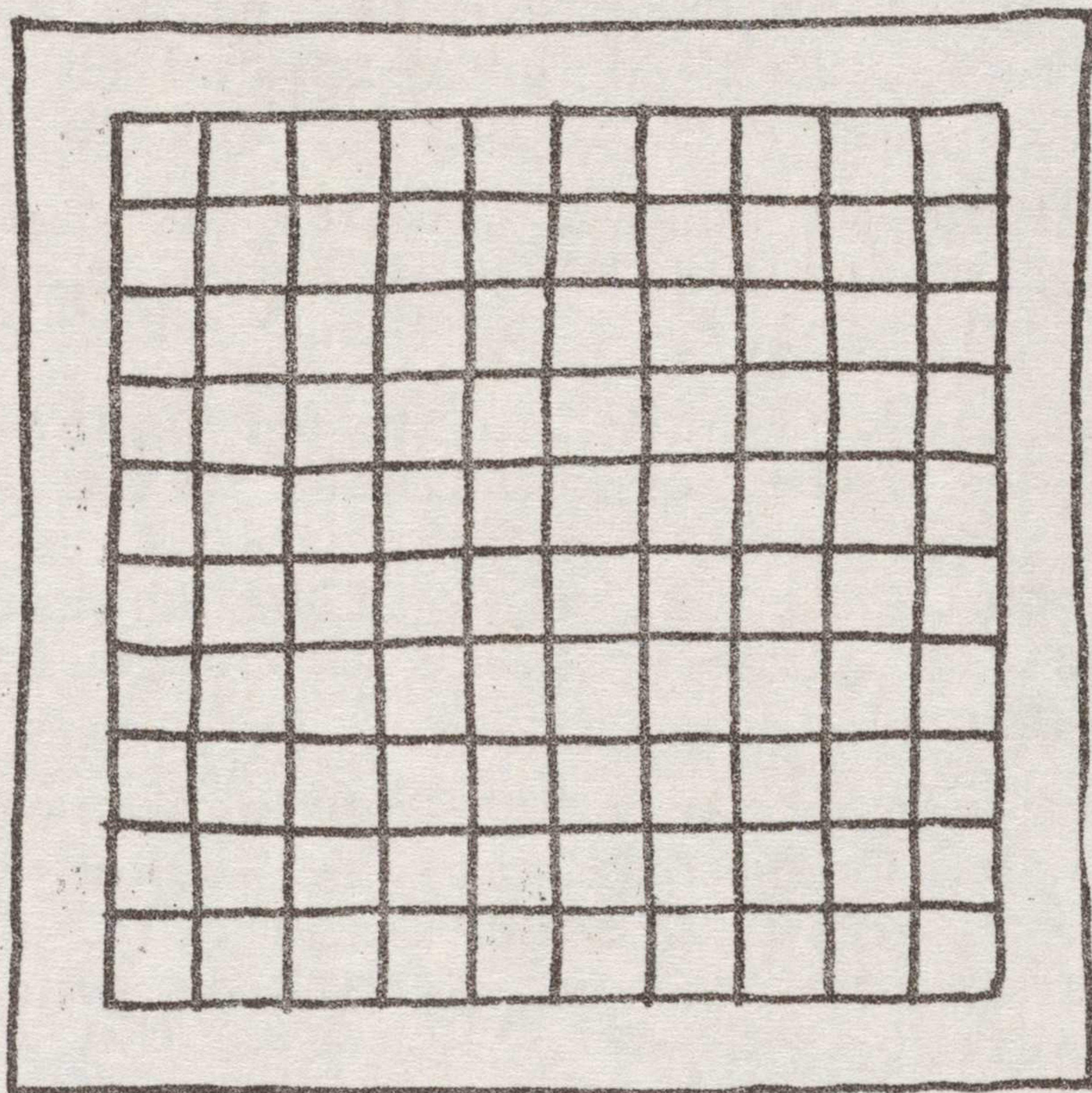
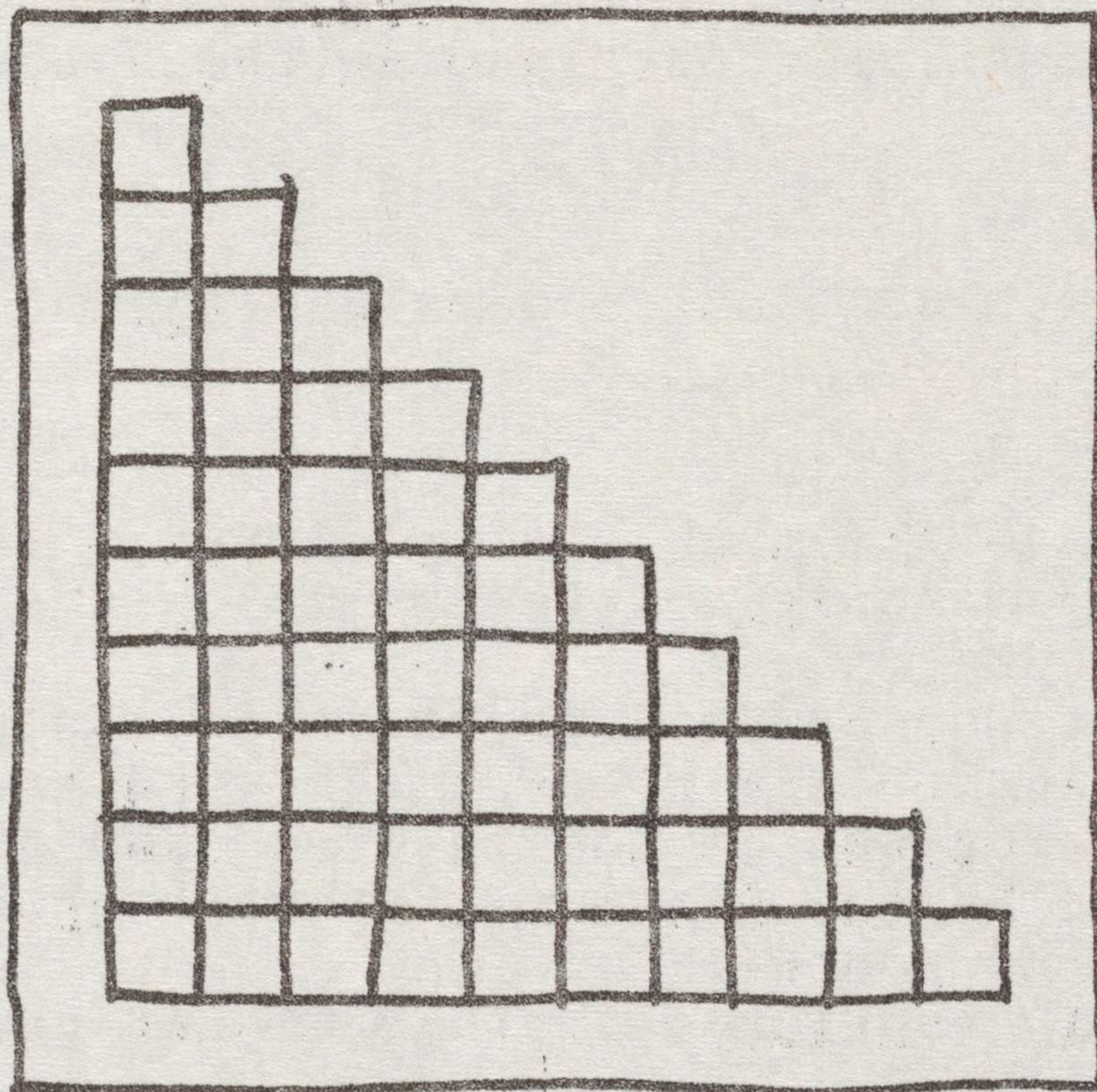


Chart IV



CHARTS - MULTIPLICATION - CONTINUED

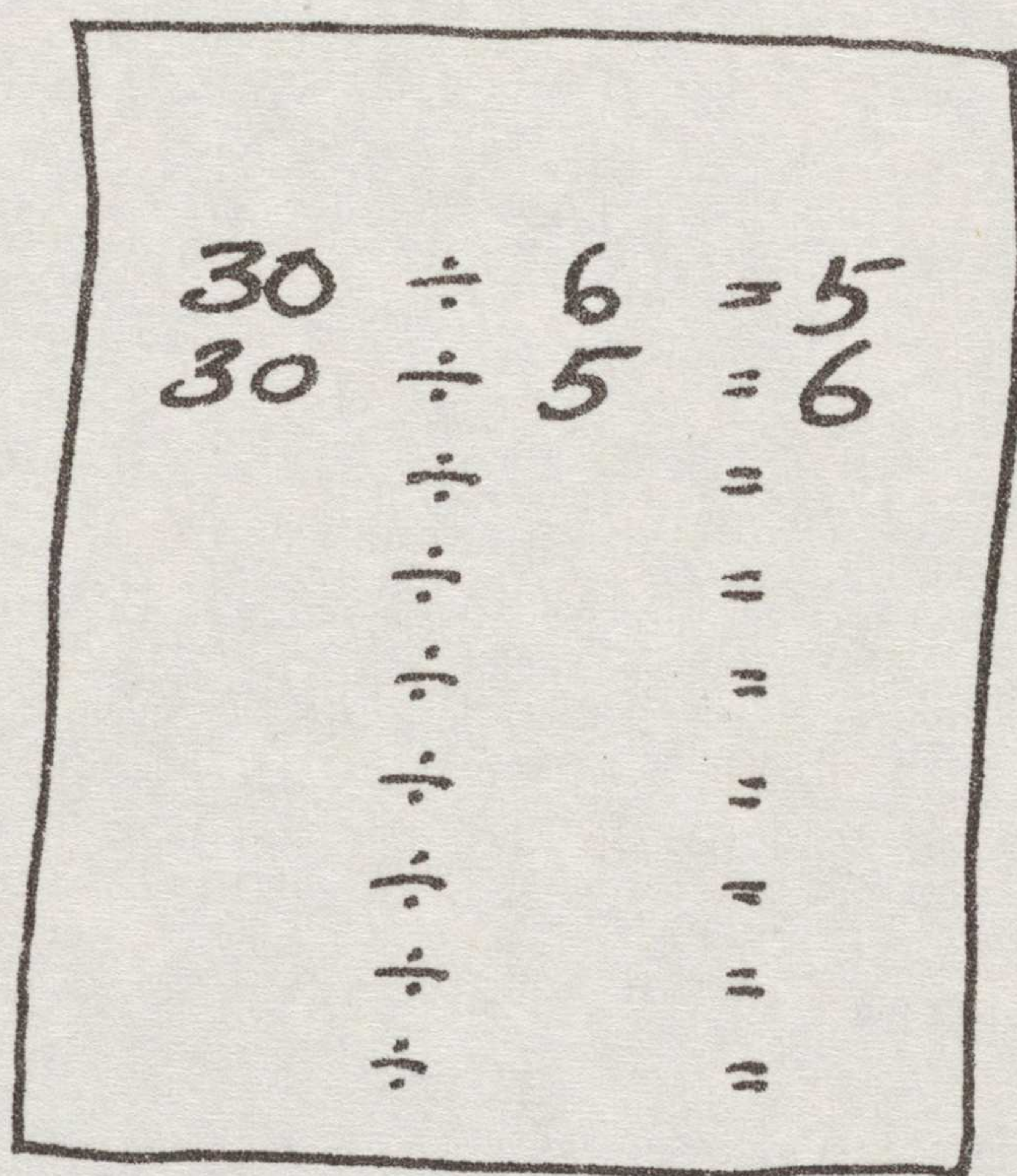
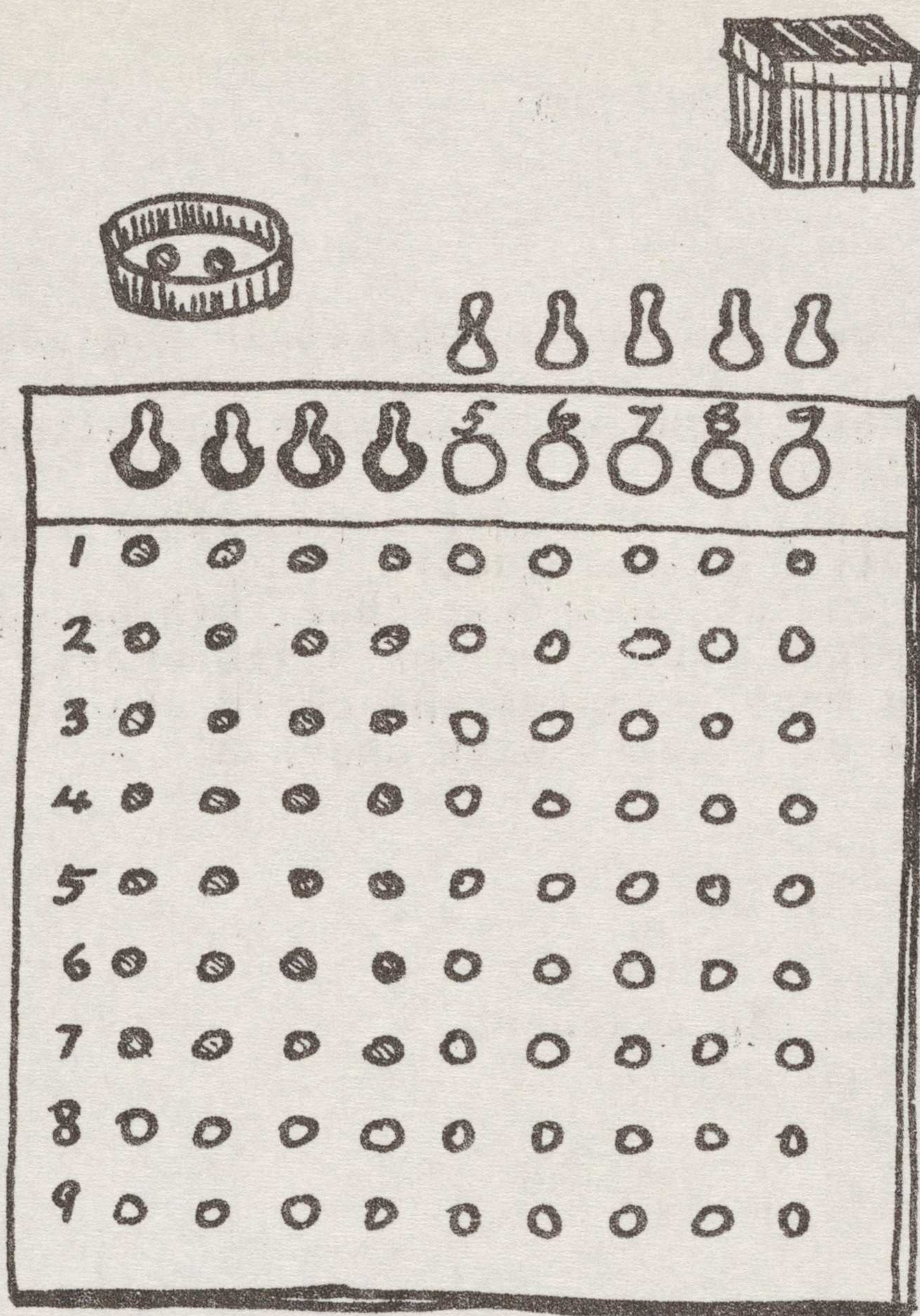
LATER EXERCISES

1. Have the child use the second basket in conjunction with charts 4 and 2.
2. Use either basket in conjunction with the blind chart and chart 3 as follows:
 - a) Child picks a slip of paper from either basket;
 - b) mentally solves the product;
 - c) places the tablet that describes this product into the appropriate square on the blind chart;
 - d) after doing many examples the child checks for correctness of results with chart 3.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Charts 1, 2 and 3 and the teacher.



Short Division Board

DIVISION BOARD**MATERIAL**

A wooden board perforated with 81 holes that are arranged in the form of a square. Above the first row of holes in a row of 9 circular grooves that are numbered in sequential order from 1 to 9. The rows of holes are also numbered in sequential order from 1 to 9.

A box that contains 9 small green skittles. A jar of 81 green beads. A division chart prepared by the teacher. A number of sets of 9 slips of paper, each set of which looks as follows:

+9=
+9=
+9=
+9=
+9=
+9=
+9=
+9=
+9=
+9=

+8=
+8=
+8=
+8=
+8=
+8=
+8=
+8=
+8=
+8=

+1=
+1=
+1=
+1=
+1=
+1=
+1=
+1=
+1=
+1=

Pencils

DIRECT AIM

To construct division tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Explain to the child that for the purposes of this exercise we are only interested in results without remainders, and not greater than 9.
2. Insert the 9 skittles into the 9 grooves.
3. Take 81 beads and divide them among 9 skittles by inserting them into the 81 holes, 9 beads to each row of holes for 9 rows.
4. Tell the child that you have divide a total of 81 beads evenly among 9 skittles with 9 beads to each skittle and, hence, that there is no remainder. Record the dividend of 81 and the result of 9, which is the number of beads in any column, on the appropriate slip of paper provided for this purpose.
5. Take that smaller number of beads - 72 - that can be divided among 9 skittles so that an equal quantity of beads is allocated to each skittle.

DIVISION BOARD - CONTINUED

6. Tell the child that you have divided a total of 72 beads evenly among 9 skittles with 8 beads to each skittle and, hence, that there is no remainder. Record the dividend of 72 and the result of 8 on the second line of the slip of paper that was used before.
7. Continue finding that total number of beads, smaller than the preceding quantity that can be divided among 9 skittles without remainder until the slip of paper is filled out. Check the recordings with the chart prepared by the teacher.

LATER EXERCISES

1. Clear the board of all beads and remove the skittle from the groove marked with the numeral 9. Explain to the child that the objective now is to find all such quantities of beads that can be divided among 8 skittles without remainders and to record on a second slip of paper these dividends and their respective results.
2. Have the child do this exercise first for 8 skittles, then for 7 skittles, and so on until all 9 slips of paper have been filled out. Ask him to check the recordings with the chart prepared by the teacher.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Chart prepared by the teacher and the teacher.

CHARTS - DIVISION

MATERIAL

One division table and one blind chart. See N. Newkirk illustration of the table and attachment for the blind chart.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of the division table. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written all pairs of dividend (81 to 1) and divisor (9 to 1) that will yield results 9 to 1 when the operation of division is performed. There is a division sign in the space between dividend and divisor and an equal sign after the divisor.

Square ruled paper and pencils.

DIRECT AIM

To use a division table in order to have the child memorize the division operations that are contained in the table.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Have the child pick a slip of paper from the basket and copy what is written on it onto a sheet of square ruled paper.
2. Show the child that the result is located on chart 1 at the intersection of the column numbered by the dividend with the row numbered by the divisor. Have the child record the result after the equal sign on his paper.
3. The child continues with the exercise until he tires of it.
4. Then he checks the results written on his paper by comparing them with those on chart 1 and makes any necessary corrections.

LATER EXERCISES

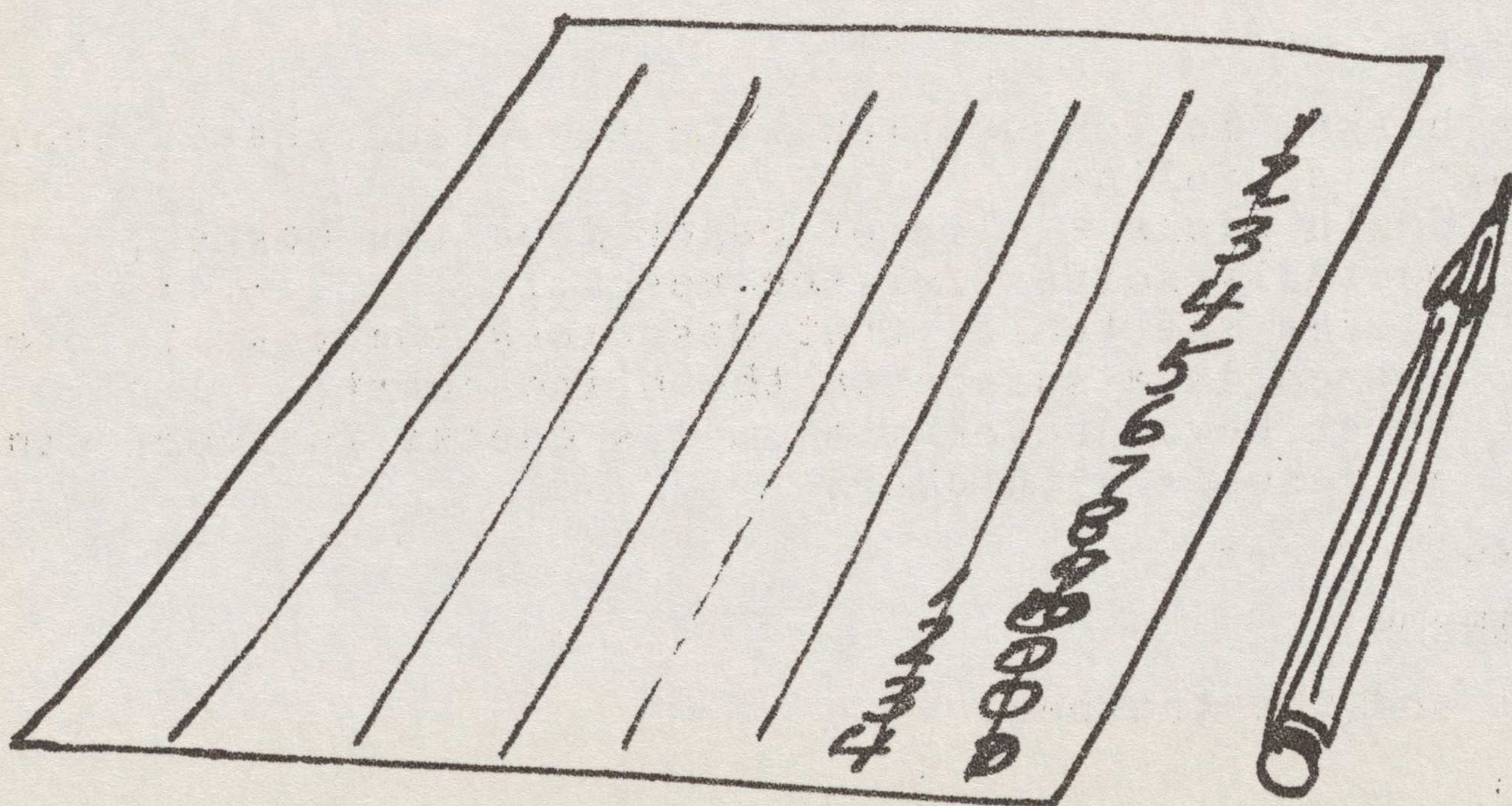
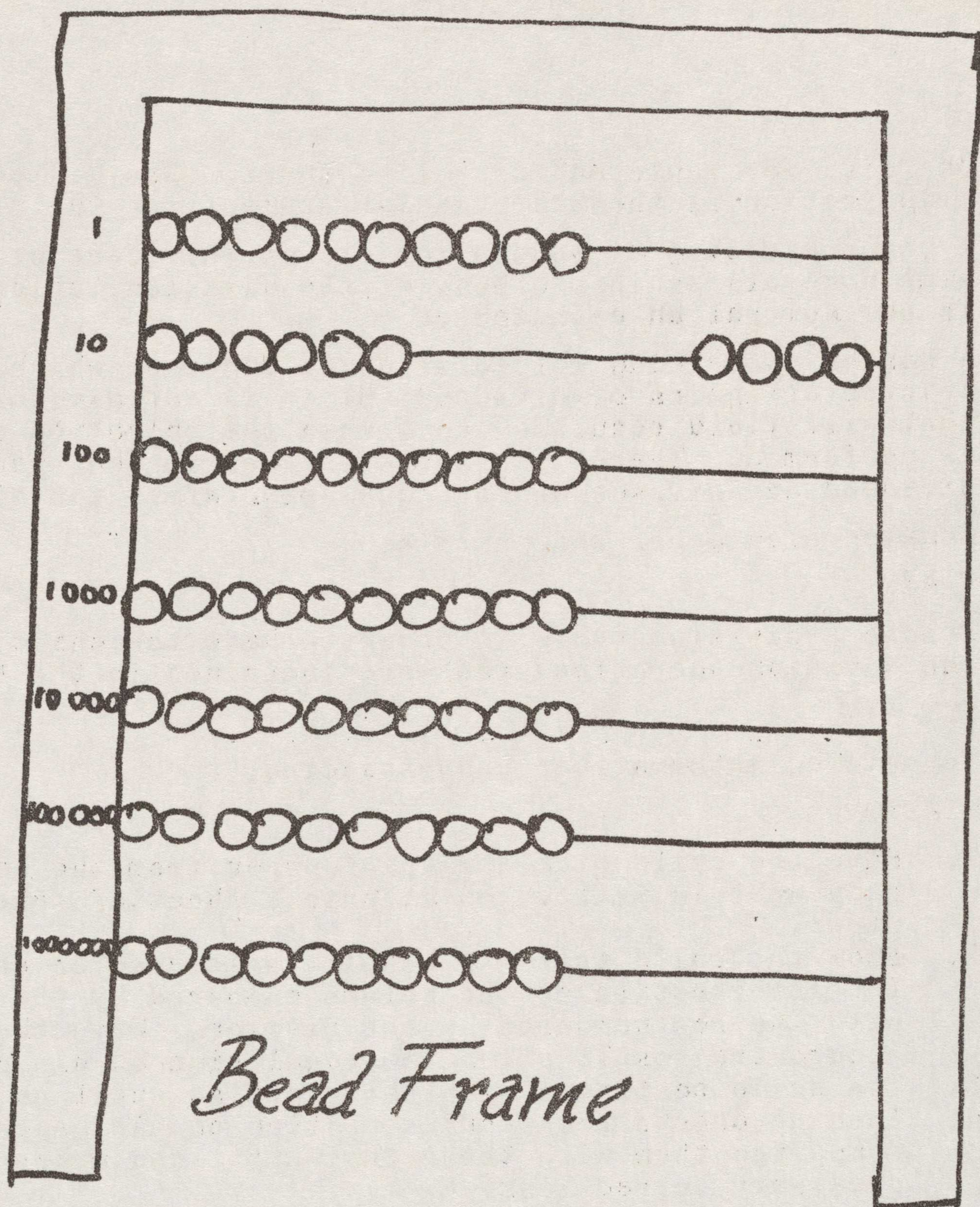
Use the basket in conjunction with the blind chart, tablets and chart 1 as follows:

- a) Child picks a slip of paper from the basket;
- b) mentally solves for the result;
- c) places the tablet that describes the result into the appropriate square on the blind chart;
- d) after doing several examples checks for correctness of results with chart 1.

AGE 5 to 7 years.

CONTROL OF ERROR

Chart 1 and the teacher.



BEAD FRAMES**MATERIAL**

A wooden frame with 7 wires stretched across it on each of which are strung 10 colored beads. The wires are numbered from top to bottom by the numerals 1, 10, 100, 1,000, 10,000, 100,000, and 1,000,000. The beads on the 1st wire are green, on the 2d blue and on the 3rd wire red. These colors are repeated in the same sequence for the beads on the next three wires. The beads on the 7th wire are green.

A wooden frame with 4 wires stretched across it on each of which are strung 10 colored beads. The wires are numbered from top to bottom by the numerals 1, 10, 100, and 1,000. The beads on the 1st wire are green, on the 2d blue, on the 3rd red and on the 4th wire green. To distinguish this frame from the preceding one, we shall refer to the latter as the "long frame" and to the former as the "short frame".

Two sets of columnar sheets of paper, one set to be used in conjunction with each frame. The set to be used with the long frame is divided into 8 columns by 7 vertical lines. The lines are labeled from left to right as follows: Millions, Hundreds of Thousands, Tens of Thousands, Units of Thousands, Hundreds, Tens and Units. The paper to be used with the short frame is divided into 5 columns by 4 vertical lines. The lines are labeled from left to right as follows: Units of Thousands, Hundreds, Tens and Units. The vertical lines in both sets of paper are of the same colors as the color of the beads to which they correspond.

DIRECT AIM

To provide the child with further practice in the writing of numerals, in counting, in the operations of addition, subtraction and multiplication - all in preparation for working with numbers in the abstract.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Show the child how to count the beads as follows:
 - a) Using the short frame, slide all beads to the left side of the frame.
 - b) Begin counting the unit beads by sliding one bead at a time to the right side of the frame. As you do so enunciate "one unit", "two units", "three units", and so on.
 - c) When all 10 unit beads have been counted in this manner, slide all 10 beads - as a unit - back to the left side of the frame. Then slide one blue bead from the

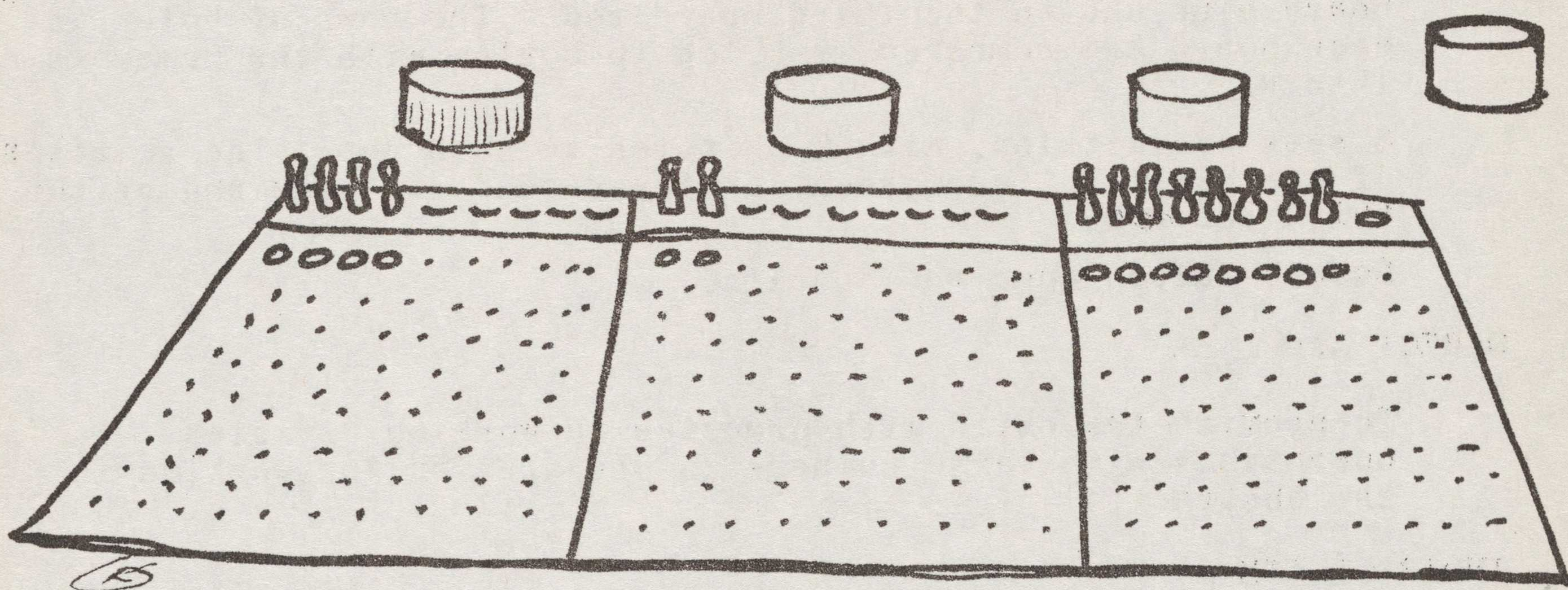
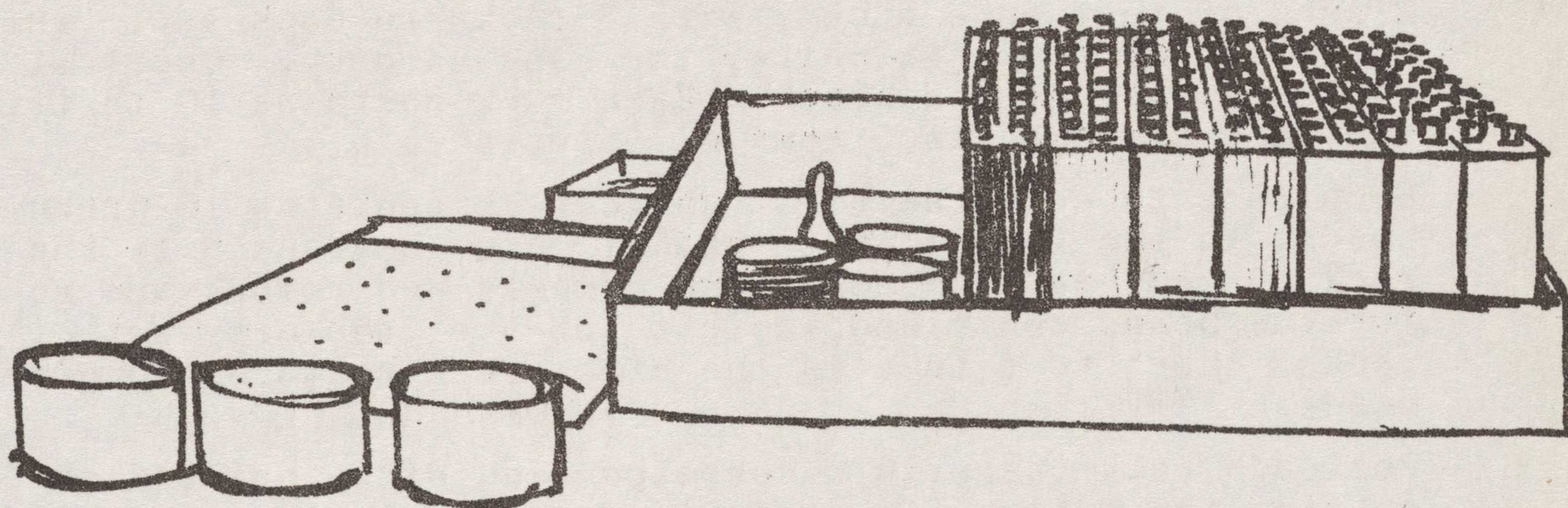
BEAD FRAMES - CONTINUED

- 2d row to the right side of the frame, enunciating - as you do so - "ten units is the same as one ten".
- d) Repeat this process for the 2d row, then 3rd, and 4th rows.
2. Record the counting on the appropriate sheet of columnar paper. Write the units 1 to 9 on the green line labeled "units", the tens - 10 to 90 - below the units on the blue and green lines, the hundreds on the red, blue and green lines and the thousands on all four lines.
 3. Compose a number with the beads by moving them to the right side of the frame. Then record it on the prepared paper, writing the numerals on the appropriate lines as described above.
 4. Perform addition operations as follows:
 - a) Write two addends on the sheet of paper;
 - b) Form the first addend with beads;
 - c) Add the units of the second addend in beads to the units of the first addend, making any necessary exchanges;
 - d) Continue adding the tens, hundreds and thousands, if any, in the same manner;
 - e) Record the total number of beads - the sum - on the paper below the second addend.
 5. Perform subtraction operations as follows:
 - a) Write the sum and first addend on the sheet of paper;
 - b) Form the sum with beads;
 - c) Subtract the number of beads in the first addend starting with the units and making all necessary exchanges;
 - d) Record the second addend - the result of the subtraction operation - on the piece of paper below the first addend.
 6. Perform multiplication operations as follows:
 - a) Write the two factors on the sheet of columnar paper. Assume, for example, that 97 is to be multiplied by 53.
 - b) Mentally solve the product $3 \times 7 = 21$ and form that quantity with beads on the right side of the frame. Record this operation;
 - c) Mentally solve the product $3 \times 90 = 270$ and add this quantity in beads to the 21 beads. Record this operation;
 - d) Mentally solve the product $5 \times 70 = 350$ and add this quantity in beads. Record this operation;
 - e) Mentally solve the product $5 \times 900 = 4500$ and add this quantity in beads. Record this operation;
 - f) Count the total number of beads on the right side of the frame and record this product - 5141 - below the factor 53 on the columnar paper.

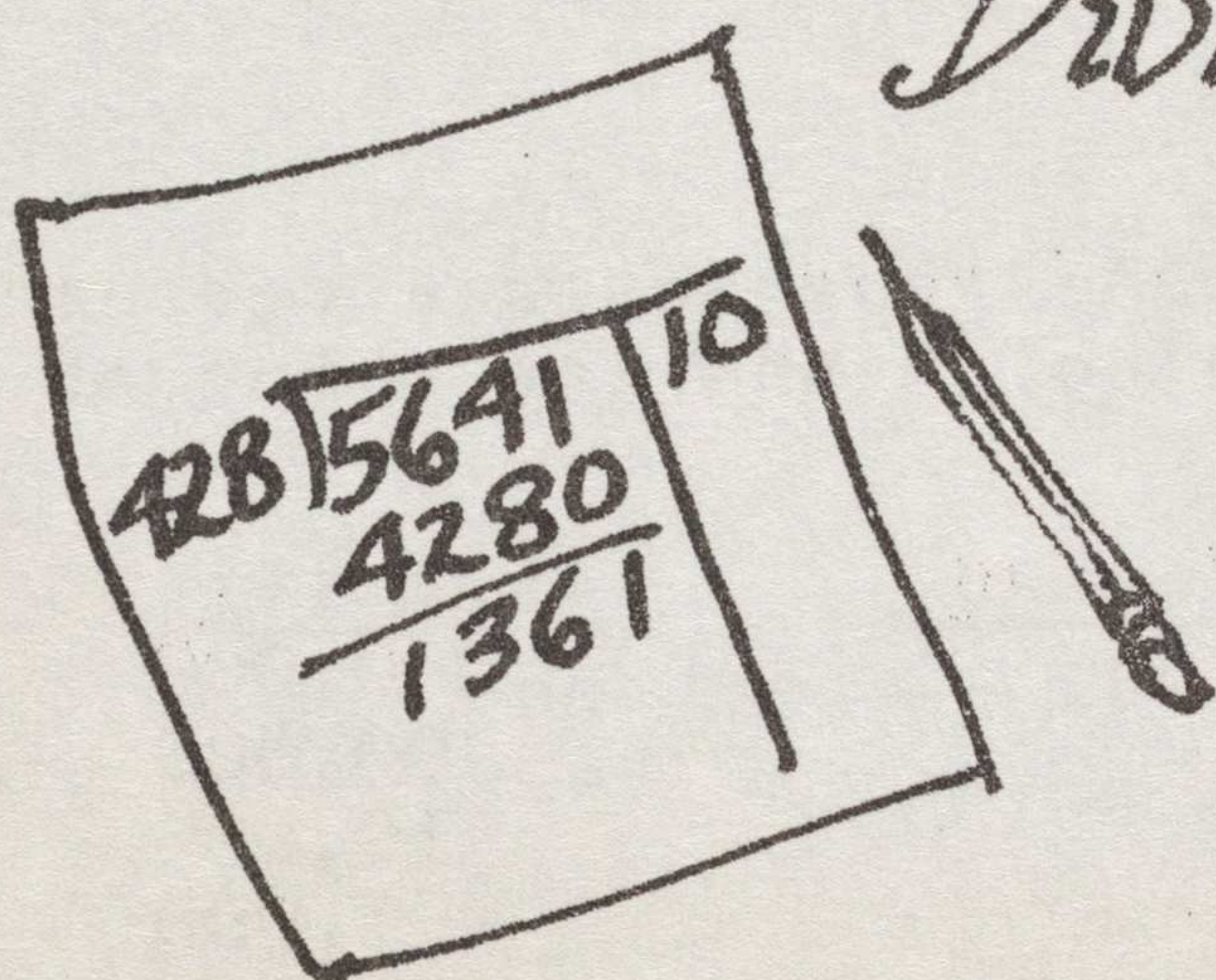
LATER EXERCISES Do the same exercises on the long frame using larger numbers.

AGE 6 to 7 years.

CONTROL OF ERROR The teacher.



Division with Beads & Boards



DIVISION WITH BEADS AND BOARDS

MATERIAL

2 sets of test tube racks, with 3 racks to each set. The first set of racks is white, the second grey. One test tube rack that is colored black. Each rack contains 10 test tubes that are arranged in 2 rows of 5 tubes each.

Each test tube in the first white rack contains 10 green beads, in the second white rack 10 blue beads and in the third rack 10 red beads. These same numbers and colors are repeated for the beads contained in test tubes of the grey set of racks. Each test tube in the black rack contains 10 green beads.

For each rack there is a corresponding dish, painted on the outside the color of the rack and on the inside the color of the beads that are in the test tubes of that rack.

3 wooden boards, each perforated with 81 holes that are arranged in the form of a square. Above the first row of holes, for each board, is a row of 9 circular grooves that are numbered in the sequential order from 1 to 9. The background for the grooves on the first board is green, on the second board blue and on the third board red. The rows of holes in each board are numbered from top to bottom with the numerals 1 to 9.

3 sets of skittles, with 9 skittles to each set. The skittles of the first set are green, of the second set blue and of the third set red.

Square ruled paper and pencils.

DIRECT AIM

To provide the child with practice in working division operations with large numbers in preparation for working in the abstract.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Explain to the child that one bead represents a certain quantity depending upon its own color and the color of the rack as follows:

<u>color of rack</u>	<u>color of bead</u>	<u>quantity</u>
black	green	1,000,000
grey	red	100,000
grey	blue	10,000
grey	green	1,000
white	red	100
white	blue	10
white	green	1

DIVISION OF BEADS AND BOARDS - CONTINUED

Explain also that the board with the red top is to be used in conjunction with the red skittles, each of which represents 100; the blue-topped board with blue skittles, each of which represents 10; and the green-topped board with the green skittles, each of which represents 1.

Note: The presentation of the material will be explained by use of an example. While the numbers in an actual situation should be larger than the ones chosen here, the principles of presentation are the same.

2. Choose a dividend and a divisor. For the purpose of the present demonstration, let these be 785 and 23, respectively.
3. Select the 3 dishes that are painted white on the outside and put 7 red beads into the dish that is painted red on the inside, 8 blue beads into the dish that is blue on the inside, and 5 green beads into the dish that is painted green on the inside. All beads must come from the test tubes of the white racks.
4. Select the blue-topped and the green-topped boards and insert 2 blue skittles into the circular grooves of the latter. (The blue-topped board will be referred to hereafter as the "1st board" and the greentopped board as the "2nd board".)
5. Place the dish containing the 7 red beads immediately above the 1st board and the dish with 8 blue beads above the 2nd board.
6. Now divide the beads among the skittles by inserting 3 blue beads into the 2nd board for every 2 red beads that have been inserted into the holes of the 1st board. Continue this pattern of distribution until the number of red beads that remain is less than the number of skittles on the 1st board. Before this point is reached, you may find that the number of green beads is exhausted. In that case, exchange 1 red bead for 10 blue beads and continue the distribution. In the present case, for example, you will find that 3 rows of 2 red beads each are placed on the 1st board, 3 rows of 3 blue beads each are placed on the 2nd board, one exchange of 1 red bead for 10 blue beads is made and that 9 blue beads remain undistributed.
7. Count the number of beads that have been distributed to any one of the skittles on the 2nd board. Since in this case the number is 3 and each blue bead represents the quantity of 10, record 30 as illustrated in the numerical recap below.
8. Count the quantity represented by the beads on the 2 boards. Record this number - 690 in the present case - similarly as illustrated below.
9. Clear the beads from the boards.
10. Continue dividing the remaining beads - in this case 95 - using the same procedure that was described above. Also record the 95 remaining beads as illustrated below.

DIVISION OF BEADS AND BOARDS - CONTINUED

11. When this distribution is completed, you will find that 4 rows of 2 blue beads each are placed onto the 1st board, 4 rows of 3 green beads each are placed on the 2d board, one exchange of 1 blue bead for 10 green beads is made and that 3 green beads remain undistributed.
12. Count the number of beads that have been distributed to any one of the skittles on the 2d board. Since in this case the number is 4 and each green bead represents the quantity of 1, record 4 as illustrated below.
13. Count the quantity represented by the beads on the 2 boards. Record this number - 92 in the present case - as illustrated below. Also record the remainder of 3.
14. Now find the total quantity that represents the result of the division operation by adding 30 and 4 as shown below.

Numerical recap:

23)785	30
690	
95	4
92	
3	34 r. 3

LATER EXERCISES

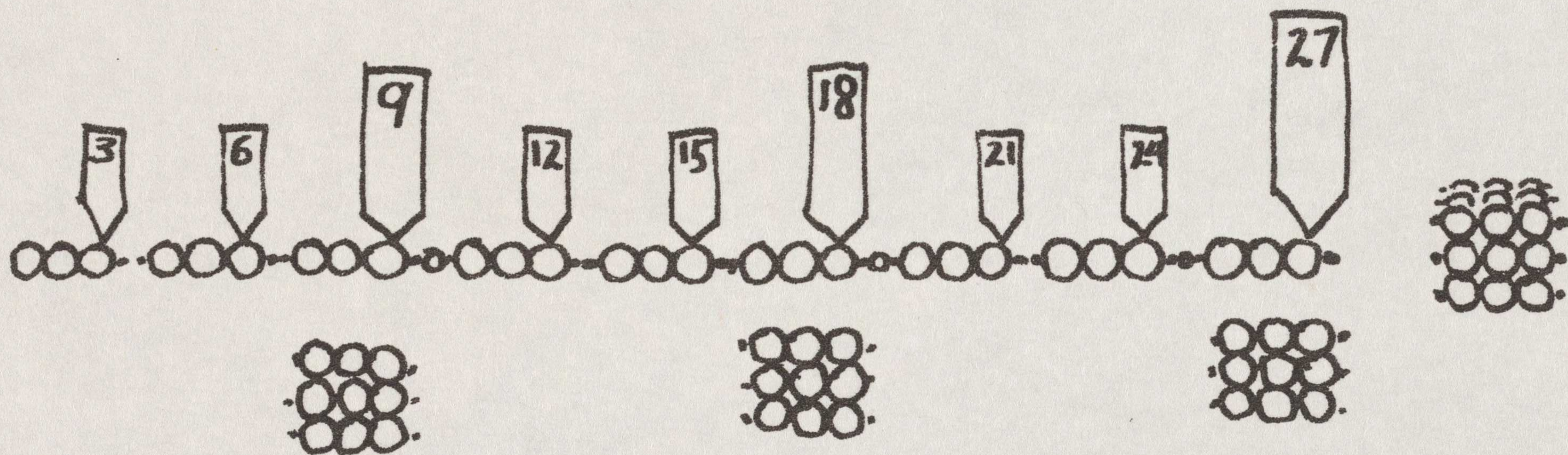
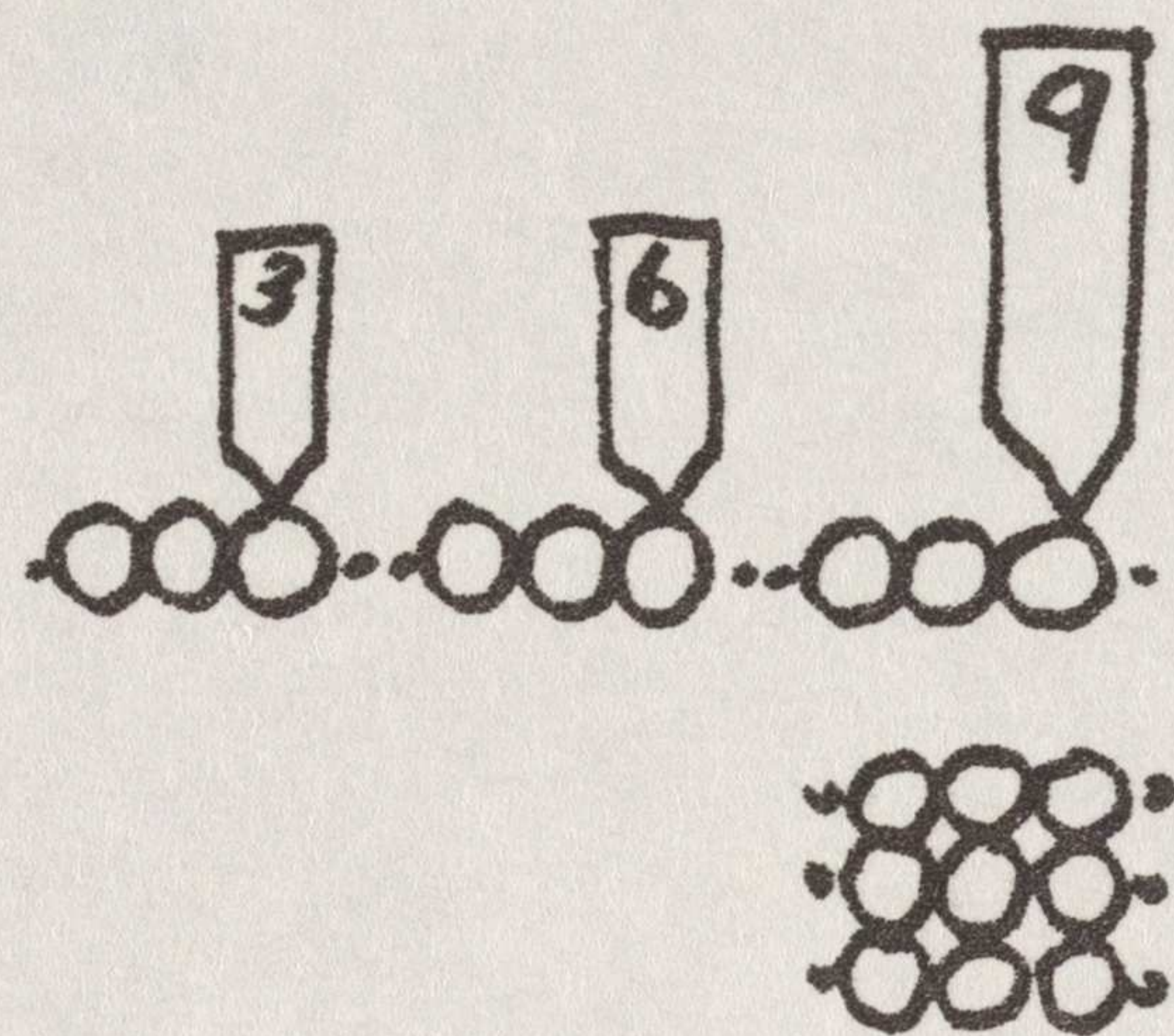
Employ larger numbers for both dividend and divisor.

AGE 6-1/2 to 7 years.

CONTROL OF ERROR

The teacher.

Squares & Cubes of Numbers



EXERCISES WITH NUMBERS

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EXERCISES WITH NUMBERSINTRODUCTION TO NUMBERS

1. Number Rods
2. Sandpaper Numerals
3. Number Rods And Numeral Cards
4. Spindle Boxes
5. Counter Exercise

THE DECIMAL SYSTEM
AND OPERATIONS

1. Introduction To The Decimal System Using Beads
2. Introduction To The Decimal System Using Numeral Cards
3. Introduction To The Decimal System Using Beads And Numeral Cards
4. Decimal System Exercise - Addition
5. Decimal System Exercise - Subtraction
6. Decimal System Exercise - Multiplication
7. Decimal System Exercise - Division
8. Stamp Games

TEENS, TENS AND COUNTING

1. Teens With Beads
2. Teens With Boards
3. Teens With Beads And Boards
4. Tens With Beads And Boards
5. Chain of 100
6. Chain of 1000
7. Bead Chains Of Varying Length

TABLES

1. Bead Snake
2. Strip Board - Addition
3. Charts - Addition
4. Negative Bead Snake
5. Strip Board - Subtraction
6. Charts - Subtraction
7. Multiplication With Bead Board
8. Multiplication Board
9. Charts - Multiplication
10. Division Board
11. Charts - Division

SUMMARY EXERCISES

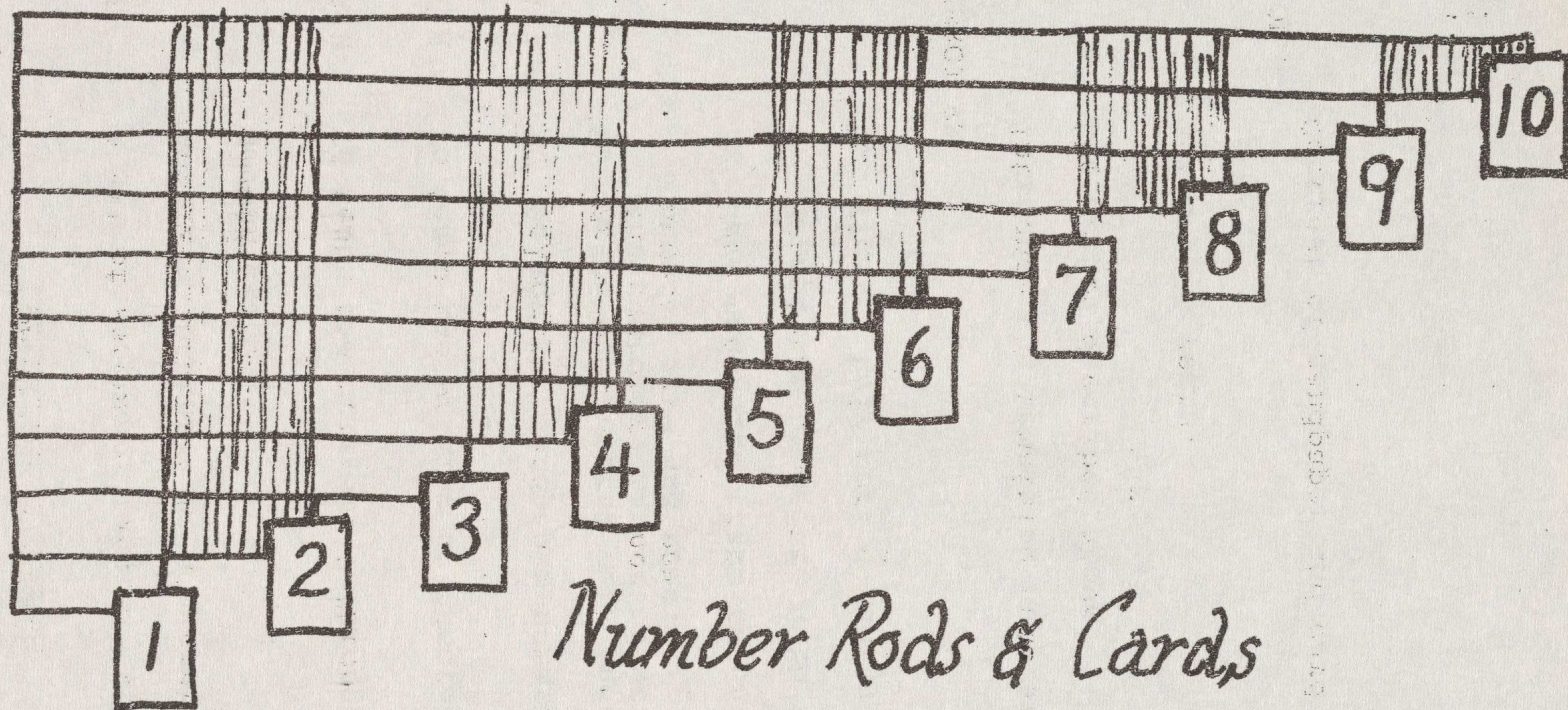
1. Bead Frames
2. Division With Beads And Boards

NUMBER RODS

MATERIAL	Ten painted wooden rods that differ in length. The shortest rod is 10 cm long with each succeeding rod differing from the preceding rod by this length. Each rod is subdivided into 10 cm segments that alternate in color in red and blue.
DIRECT AIM	1. To teach the names of the numbers 1 through 10; that each number represents a quantity of objects; and that there is a proper sequence to the numbers. 2. To introduce the arithmetical operations of "addition" and its inverse. 3. To introduce the arithmetical terms of "greater than", "less than" and "equal to".
INDIRECT AIM	To develop mathematical understanding.
PRESENTATION	1. Build a stair like structure beginning with the unit rod. 2. Select the unit rod, and the rod with two segments. Teach the numbers "one" and "two" with this material by means of the three period lesson.
LATER EXERCISES	1. Gradually introduce the other rods until the supply is exhausted. 2. Demonstrate the operations of "sum" and "difference". 3. Demonstrate the terms "greater than", "less than", and "equal to".
AGE	3-1/2 to 4 years.
CONTROL OF ERROR	The teacher.

SANDPAPER NUMERALS

- MATERIAL A set of sandpaper figures cut out in the form of the numerals "0" through "9", each mounted on a separate smooth card.
- DIRECT AIM To teach the numerals 0 through 9.
- INDIRECT AIM To teach the writing of numerals.
- PRESENTATION 1. Select the sandpaper numerals "1" and "2".
2. Trace one numeral with index and middle fingers in the customary manner of writing. While tracing the numeral give the name.
3. Have the child trace the numeral and give its name.
4. Repeat the procedure with the other numeral.
5. Finish their period naming lesson.
- LATER EXERCISES
- Introduce the remaining numerals in random order and in the method described above.
- AGE 3-1/2 to 4 years.
- CONTROL OF ERROR Contrast of sandpaper and card surfaces.



Number Rods & Cards

NUMBER RODS AND NUMERAL CARDS

MATERIAL Number Rods and a set of nine cards each marked with a numeral 1 through 9.

DIRECT AIM 1. To associate numbers 1 - 9 with the numerals 1 - 9.
 2. To teach numerical sequence.

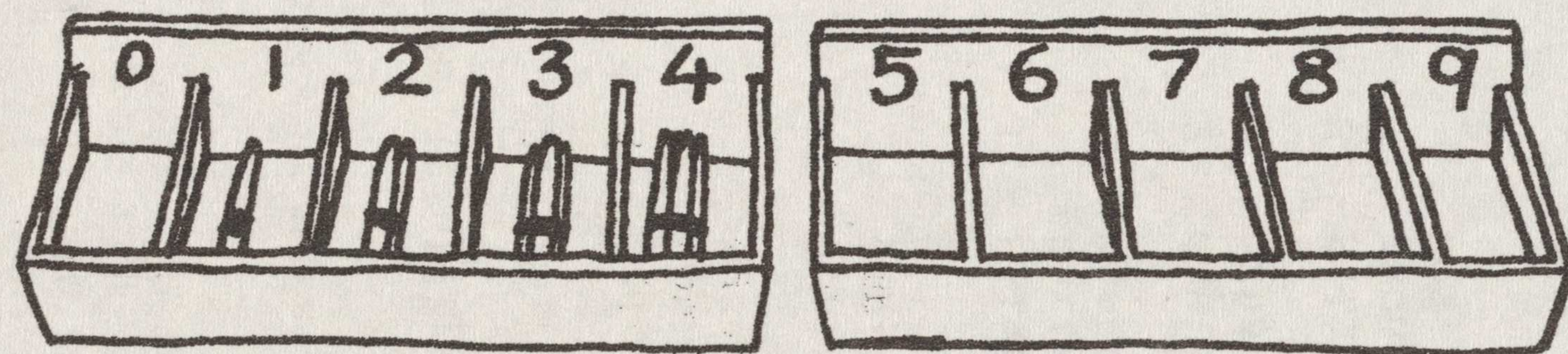
INDIRECT AIM Preparation for mathematical understanding.

PRESENTATION 1. Place all rods on a rug in mixed order.
 2. Place all numeral cards on the rug in mixed order.
 3. Select a numeral card and ask the child to hand you the corresponding rod. Place the card upright against one end of the rod.
 4. Continue matching rod with card until all cards are employed.

LATER
EXERCISES 1. Select a number rod and ask the child to find the corresponding numeral card. Place the card against one end of the rod.
 2. Continue matching card with rod until all cards are exhausted.
 3. Build a stairlike pattern from the rods placing each numeral card against the end of the appropriate rod. The numeral cards are then in sequential order.

AGE 4 years.

CONTROL OF
ERROR The teacher.



Spindle Boxes

SPINDLE BOXES

MATERIAL	Two polished wooden boxes, each with five compartments. The compartments are marked sequentially by the numerals 0 through 9. A basket containing 45 wooden spindles and 9 rubber bands.
DIRECT AIM	To introduce the numeral zero and its meaning. To show that numerals symbolize quantities of separate objects.
INDIRECT AIM	To develop mathematical understanding.
PRESENTATION	1. Enunciate the numeral "one" that marks the second compartment, and put one spindle with a rubber band around it into it. 2. Enunciate the numeral "2" that marks the third compartment. Select two spindles, place a rubber band around them and put the two spindles as a unit into this compartment. 3. Continue in this manner until the exercise is completed. 4. Draw the child's attention to the fact that the compartment marked by 0 remains empty.
LATER EXERCISES	Note: This exercise is done with a group of children. Ask one child to bring you seven pencils, another two cubes, a third zero rods, and so on.
AGE	3-1/2 to 4 years.
CONTROL OF ERROR	The teacher.

1

0

2

0

0

3

0

0

4

0

0

0

0

5

0

0

0

0

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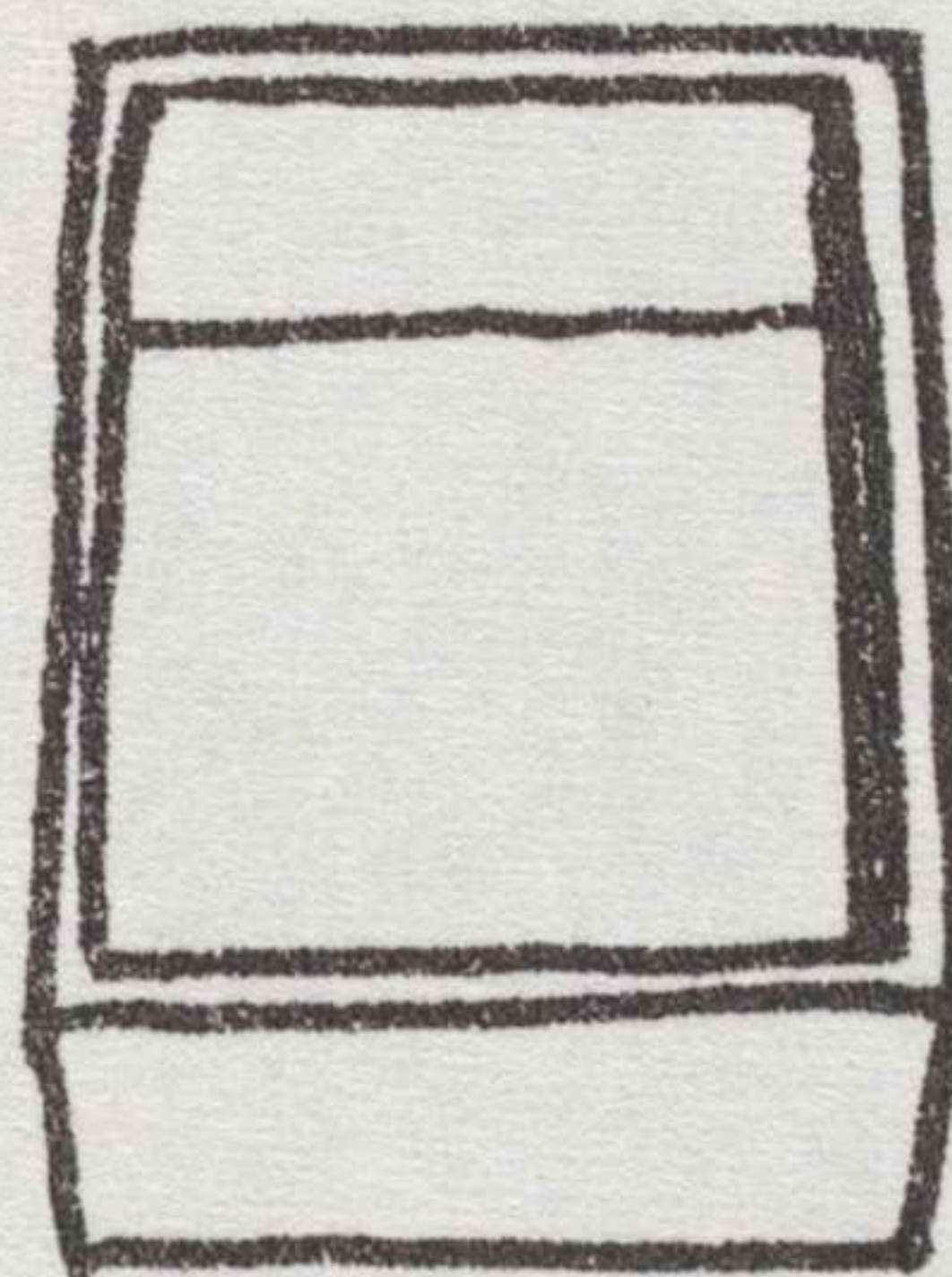
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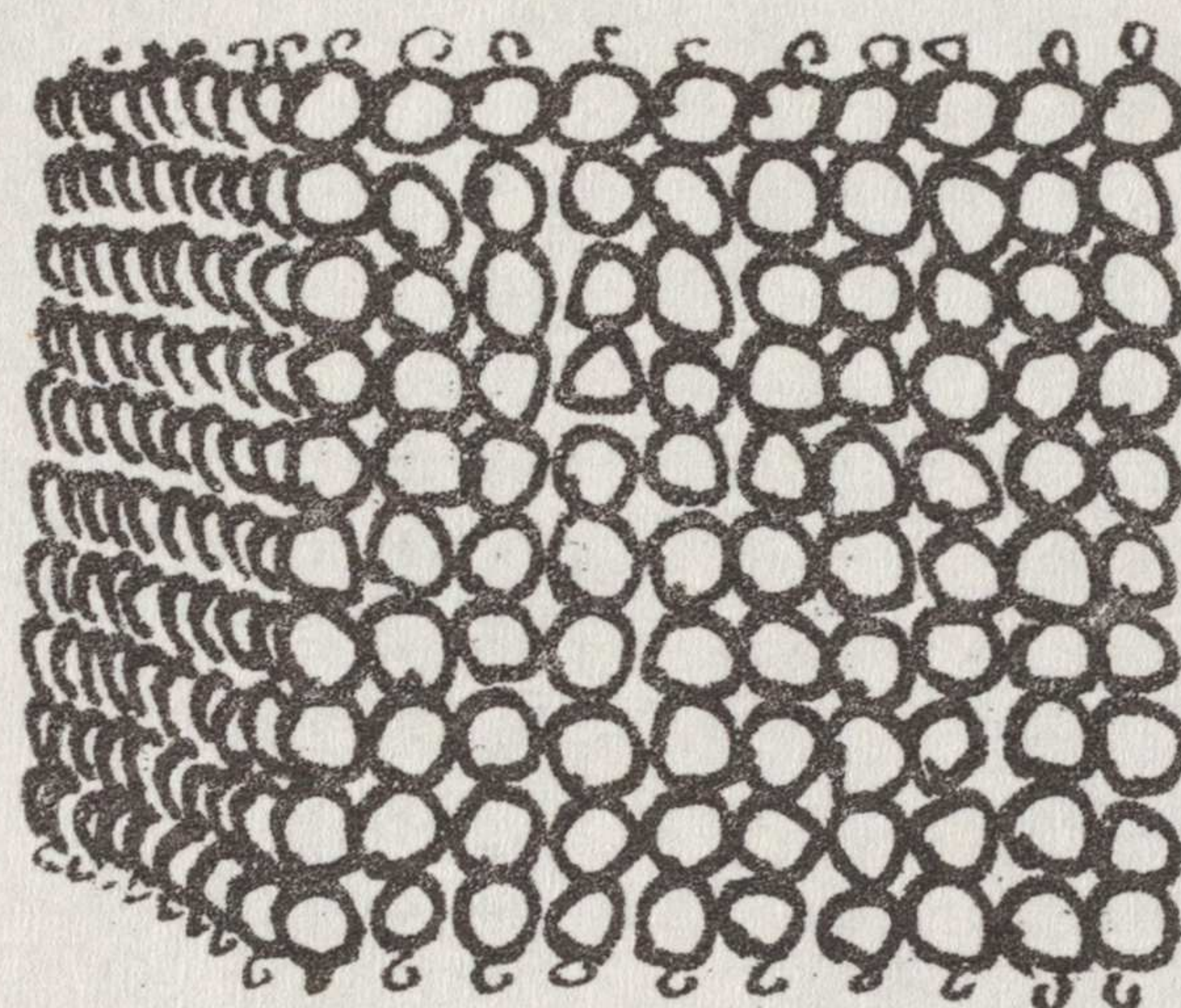
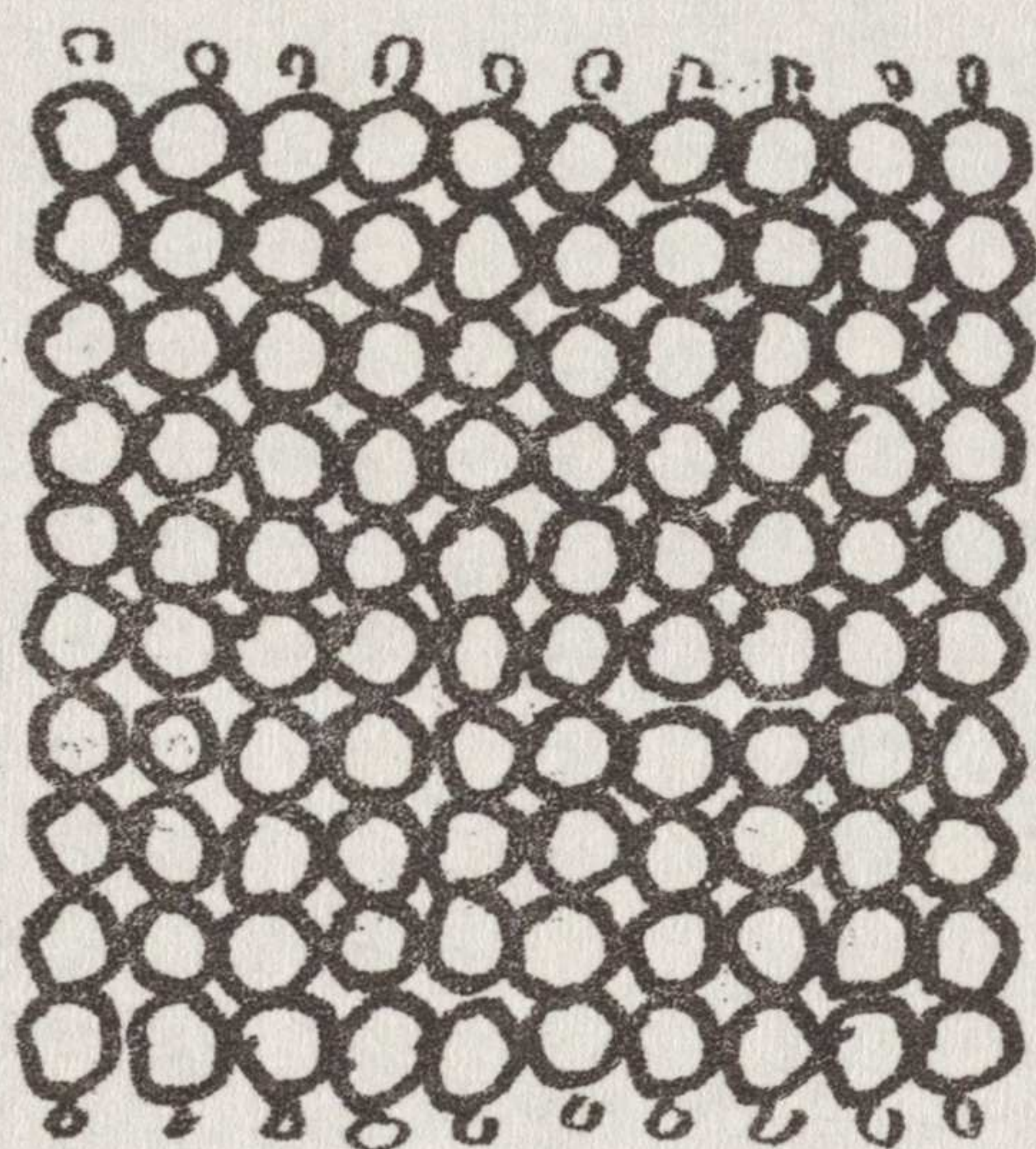
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Counters

COUNTER EXERCISE

- MATERIAL**
1. A set of numerals 1 through 9 and 45 counters (or chips) in a box.
 2. A box that contains a number of folded slips of paper on each of which is written any one of the numerals 0 through 9.
- DIRECT AIM**
1. To test the child's facility with the ordinal numbers.
 2. To test the child's ability to associate the numbers 1 through 9 with the appropriate numerals.
- PRESENTATION**
1. Ask the child to arrange the mixed numerals in ordinal sequence in a column leaving a small space between any two numerals.
 2. Have the child enunciate each numeral in sequence. Then ask him to hand you one counter. Place this counter beside the numeral 1.
 3. Ask the child for two counters and place these in a row beside the numeral 2.
 4. Ask the child for 3 counters. Arrange the three counters beside the numeral 3 so that the first row will contain 2 counters and the third counter is placed in the second row and first column.
 5. Continue in this manner until all counters have been placed.
- LATER EXERCISES**
- Note: This exercise is done with a group of children.
1. Have each child pick a piece of paper from the box, unfold it, read the numeral (silently), refold the piece of paper and place the slip on his table.
 2. Ask each child in the group to go and bring back to his table the number of objects indicated by the numeral on his slip. The objects must come from within the room and all children do this exercise simultaneously.
 3. Ask each child to read the numeral on his slip of paper and count the objects that he has collected, all under your supervision.
- AGE** 3-1/2 to 4 years.
- CONTROL OF ERROR** The teacher.



Golden Bead Material

INTRODUCTION TO THE DECIMAL SYSTEM USING BEADS

MATERIAL

1. On a wooden tray: one gold bead, one bar of 10 gold beads, one square of 10 bead bars, and one cube of 10 bead squares.
2. Four wooden trays: ten^{bead}/cubes on one tray, ten bead squares on the second tray, ten bead bars and a bowl of ten beads on the third tray, and the fourth tray empty.

DIRECT AIM

1. To teach names of the following quantities: unit, ten, hundred and thousand.
2. To shew relationships between these quantities.

INDIRECT AIR

To develop mathematical understanding.

PRESENTATION

1. Using the material described in (1) above employ the three period lesson to teach the names "unit" ("one") and "ten", then "hundred" and "thousand".
2. Show that one bead-bar is composed of ten unit beads, one bead square of ten bead bars, that one bead cube is composed of ten bead squares.

LATER EXERCISES

1. Using the material described in (2) above, ask a child to bring on the empty tray a certain number of one of the decimal groups, e.g., 9 "hundreds". Verify the quantity.
2. Ask the child to bring varying numbers first of two, then of three, and finally of four decimal groups.

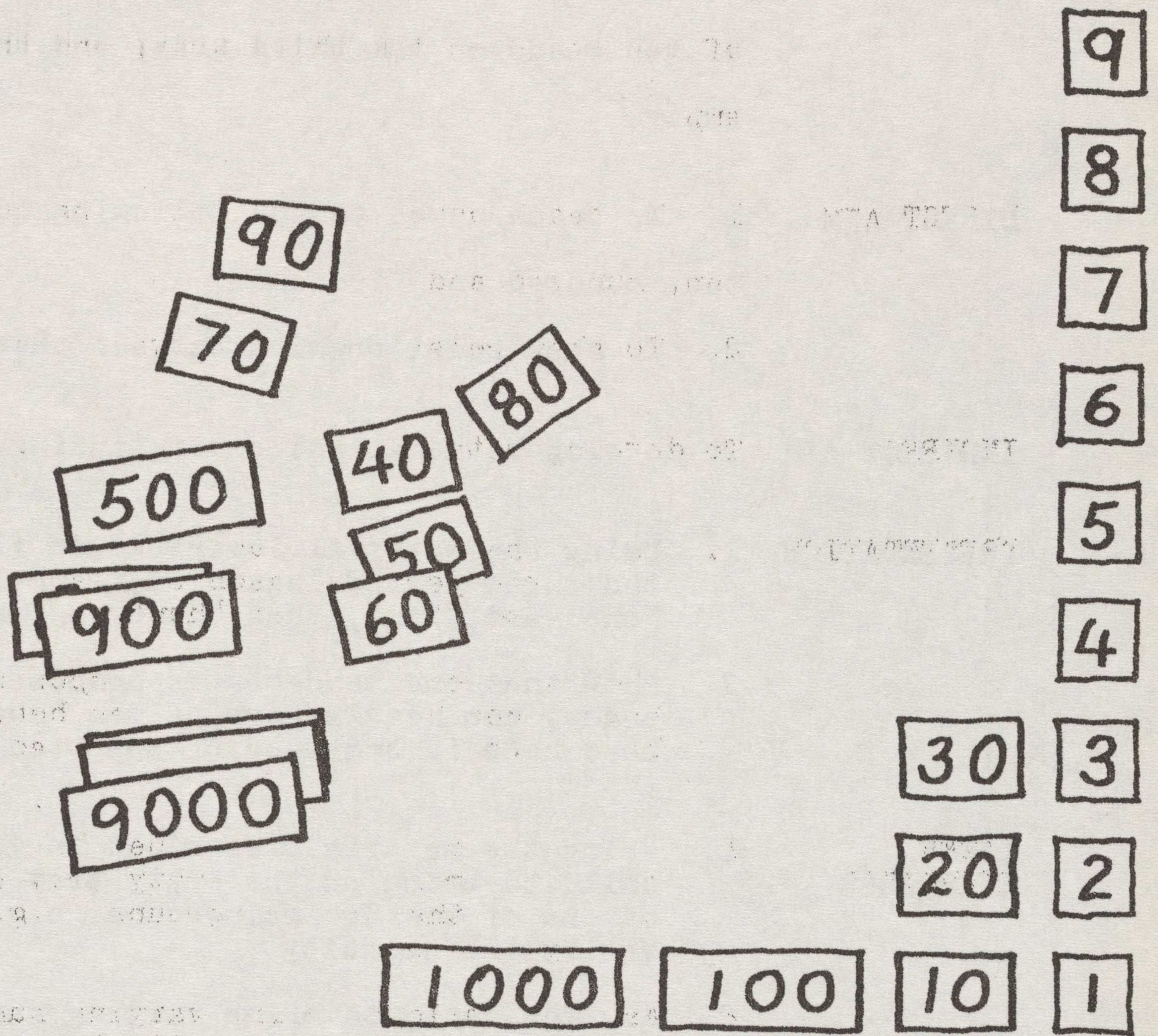
AGE

4 years.

CONTROL OF ERROR

The teacher.

Decimal Cards



INTRODUCTION TO THE DECIMAL SYSTEM USING NUMERAL CARDS

MATERIAL

1. A box containing four sets of large numeral cards as follows:
 - a) numerals 1 through 9 printed in green.
 - b) two-digit numerals 10, 20, ... 90 printed in blue.
 - c) three-digit numerals 100, 200, ... 900 printed in red.
 - d) four-digit numerals 1000, 2000, ... printed in green.
 Cards vary in size proportionately to the number of digits in the numeral.
2. One empty tray.

DIRECT AIM

To teach the names of the numerals.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: ensure that the child views the cards from the correct position.

1. Count through the set of unit cards.
2. Take the 10-card and 100-card and teach the names of these numerals using the three period lesson.
3. Count through the set of cards, with the two-digit numerals enunciating "one ten", "two-tens", "three tens", etc. Repeat this procedure with the set of cards that have the three-digit numerals.

LATER EXERCISES

1. In the way of review, repeat the presentation (2) above, then select the 1000-card and teach the name of this numeral.
2. Repeat the presentation of (3) above, enunciating "one thousand", "two thousands", "three thousands", etc.
3. Place the numeral cards on a floor mat so that each set will form a column beginning with the lowest numeral at the top and the highest numeral at the bottom.
4. Ask the child to bring on the tray a specified numeral card.
5. Ask the child to bring on the tray two, then three, then four specified numeral cards.
6. Show the child how the separate numeral cards will combine to form one numeral.

AGE 4 to 4-1/2 years.

CONTROL OF ERROR

The teacher.

INTRODUCTION TO THE DECIMAL SYSTEM

USING BEADS AND NUMERAL CARDS

MATERIAL

Four wooden trays: ten bead cubes on the tray, ten bead squares on the second tray, ten bead bars and a bowl of ten beads on the third tray and one empty tray. A small bowl and one set of large numeral cards.

DIRECT AIM

To associate number with decimal numeral.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Place on the child's tray numeral cards chosen from varying decimal groups.
2. Ask the child to bring the number of beads indicated by the numeral cards. Count to verify.
3. Slide the numeral cards together to form one numeral.
4. Ask the child to read the numeral.

AGE 4-1/2 to 5 years.

CONTROL OF ERROR

The teacher.

DECIMAL SYSTEM EXERCISE - ADDITION

MATERIAL Gold bead material as follows: single beads, bars, and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Three wooden trays one of which is larger than the other three. Four small bowls, one on each tray.

DIRECT AIM To do the operation of addition using large sets.

INDIRECT AIM To develop mathematical understanding.

PRESENTATION Note: This exercise is done with a group of 4 children.

1. Place the three sets of numeral cards on floor mats so that each set will form a column in which the initial digits are arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Select two sets of small numeral cards and place each set on a small tray. Each set will consist of one of the unit cards, one of the "ten" cards and one of the "hundred" cards. The cards must be chosen such that the sum of the unit numerals exceeds 10.
4. Ask each child to bring on his tray the quantity of beads indicated by the numeral cards on his tray. The children will then place their trays on the floor mat in one column, with the numeral cards on the right and the beads on the left side of the trays.
5. Now transfer the bead material from the small trays onto the large tray which will have been placed below the column of the two small trays.
6. Sort the bead material into separate groups of units, bars, and squares.
7. Count the quantity of beads. You will find that there will be more than 10 unit beads. Exchange sets of 10 beads for as many bead bars.
8. Find the combination of large numeral cards that represent the quantity of beads on the tray and place them to the right of the beads.
9. Recapitulate the presentation by telling the children that you have united two quantities to form one large quantity.

LATER EXERCISES

1. Construct exercises that will require the exchange of bars for squares and squares for cubes, as unit beads were exchanged for bars in (7) above.
2. Ask a child to take the place of the teacher.

AGE 4-1/2 to 5 years

CONTROL OF ERROR The teacher.

DECIMAL SYSTEM EXERCISE - SUBTRACTION

MATERIAL

Gold bead material as follows: single beads, bars and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Three wooden trays one of which is larger than the other two. Three small bowls, one for each tray.

DIRECT AIM

To do the operation of subtraction as the inverse of addition.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: this exercise is done with a group of three children.

1. Place the three sets of numeral cards on floor mats so that each set will form a column in which the initial digit is arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Form a three or four digit numeral with large numeral cards and place on the large tray.
4. Ask the child to bring on the large tray the quantity of beads indicated by the numeral. Have him place the beads to the left of the numeral cards.
5. Using the small cards, form a numeral smaller than the first and place it on a small tray. This tray is then placed below the large tray.
6. Explain to the children that the small numeral indicates the number of beads to be separated from the quantity of beads on the large tray. Execute the separation by placing the indicated quantity of beads on the small tray to the left of the cards. During the separation regroup bead cubes into bead squares, squares into bars and bars into single beads, to the extent necessary.
7. Count the quantity of beads that forms the remainder on the large tray. As the remainder is counted it is placed on a second small tray below the other two trays. Then form the numeral in small cards that represents the quantity of beads on the tray. Place the numeral to the right of the beads.
8. Recapitulate the presentation by telling the children that the large quantity has been separated into two quantities.

LATER EXERCISES

1. Ask a child to take the place of the teacher.
2. Show how a difference between two quantities can be found by mapping one quantity onto another.

AGE 4-1/2 to 5 years.

CONTROL OF ERROR The teacher.

DECIMAL SYSTEM EXERCISE - MULTIPLICATION

MATERIAL

Gold bead material as follows: single beads, bars, and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Three wooden trays one of which is larger than the other two. Three small bowls, one on each tray.

DIRECT AIM

To do the operation of multiplication as the union of equal sets.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: This exercise is done with a group of 3 children.

1. Place the four sets of numeral cards on floor mats so that each set will form a column in which the initial digits are arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Select two identical sets of small numeral cards and place each set on a small tray. Emphasize that the sets are identical.
4. Ask each child to bring on his tray the quantity of beads indicated by the numeral cards on his tray. The children will then place their trays on the floor mat in one column, with the numeral cards on the right and the beads on the left side of the trays.
5. Now transfer the bead material from the small trays onto the large tray which will have been placed below the column of the three small trays.
6. Sort the bead material into separate groups of units, bars, and squares.
7. Count the quantity of beads. Make necessary exchanges as in the "addition" exercise.
8. Find the combination of large numeral cards that represent the quantity of beads on the tray and place them to the right of the beads.
9. Recapitulate the presentation by telling the children that you have united two equal quantities to form one larger quantity.

LATER EXERCISE

Ask the child to take the place of the teacher.

AGE 4-1/2 to 5 years

CONTROL OF ERROR
The teacher.

DECIMAL SYSTEM EXERCISE - DIVISION

MATERIAL

Gold bead material as follows: single beads, bars and squares - 27 of each; 9 bead cubes. One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000. Five wooden trays, one large, one of medium size and three small trays. One bowl to each tray.

A basket containing 9 small, green ribbon bows and one large bow in light-blue ribbon.

DIRECT AIM

To do the operation of division.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

Note: this exercise is done with a group of four children.

1. Place the three sets of numeral cards on floor mats so that each set will form a column in which the initial digit is arranged in ordinal number sequence.
2. Station a child at the shelf where the bead material is located. His role will be to distribute the material.
3. Form a four-digit numeral with large cards and place on the large tray.
4. Ask a child to bring on the large tray the quantity of beads indicated by the numeral. Have him place the beads to the left of the numeral cards.
5. Explain to the children that this is the quantity to be separated into three smaller equal quantities. That is to say, that each child will receive the same quantity of beads on his tray. Execute the separation by first distributing the bead cubes. When an equal distribution cannot be made, exchange the remaining cubes for bead squares. Then distribute the squares and, when necessary, exchange the remaining squares for bead bars. Continue this process until the even distribution has been made.
6. Ask each child to count the quantity of beads on his tray and then to find the small numeral cards that will represent this quantity. Have him place the cards to the right of the beads.
7. Ask the children to place their trays side-by-side in a row and below the large tray.
8. If any beads still remain on the large tray, place these beads below the row of small trays. Ask a child to find the small numeral card that represents the remainder.
9. Recapitulate the presentation by telling the children that the large quantity of beads has been divided into three smaller but equal quantities and a remainder.

DECIMAL SYSTEM EXERCISE - DIVISION - CONTINUED

LATER EXERCISES

Note: for part of the following exercise 12 children will be required.

1. Ask a child to take the teacher's place.
2. Present a division exercise where the large quantity of beads is to be divided into 12 equal groups.
 - a) Present the exercise in the same manner as described above except for the following differences:
 - b) Have ten of the children represented by one child who will wear a blue bow. The two children that act on their own behalf will wear a green bow each.
 - c) Divide the quantity of beads as represented by the numeral cards into three parts, by giving the child with the blue bow always 10 times the quantity of beads that either of the other two children receives.
In so doing exchange bead cubes for squares, squares for bars and/or bars for single beads at such times when the next distribution would make a 10:1 division not possible. The child who wears the blue bow will use the medium-sized tray.
 - d) When the division has been completed, call the nine children that were represented by the one child and ask them to stand in a group with the child who represented them.
 - e) Recapitulate the exercise by explaining to the children that the large quantity has now been divided into three quantities - two equal and one ten times that of either of the two; - hence, that the original large quantity of beads can be divided into 12 equal quantities by applying the same general procedure in dividing the quantity of beads on the medium-sized tray into ten equal groups.
 - f) Emphasize the quantity of beads in one of the equal groups and the remainder.

AGE 5 - 6-1/2 years.

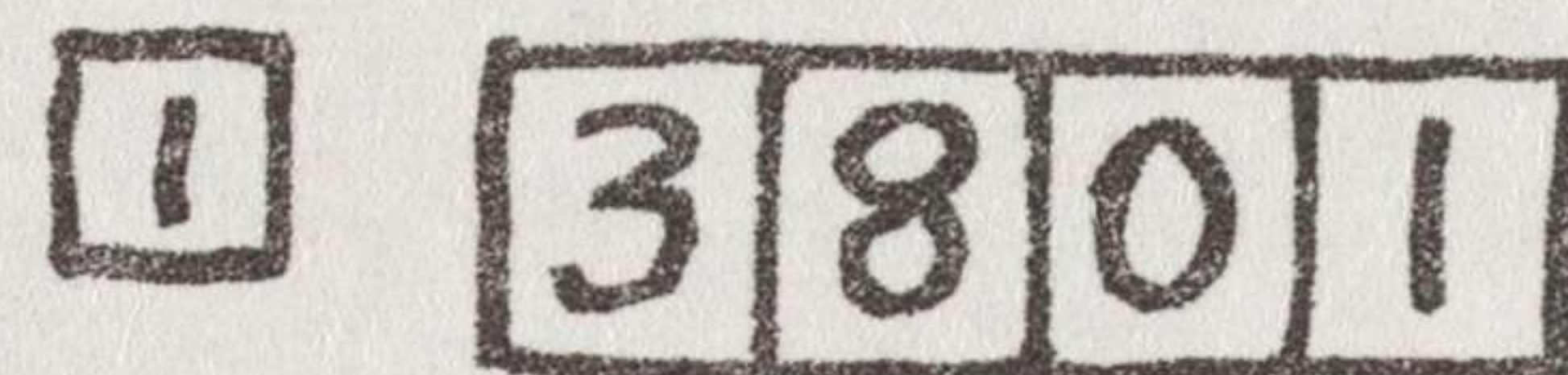
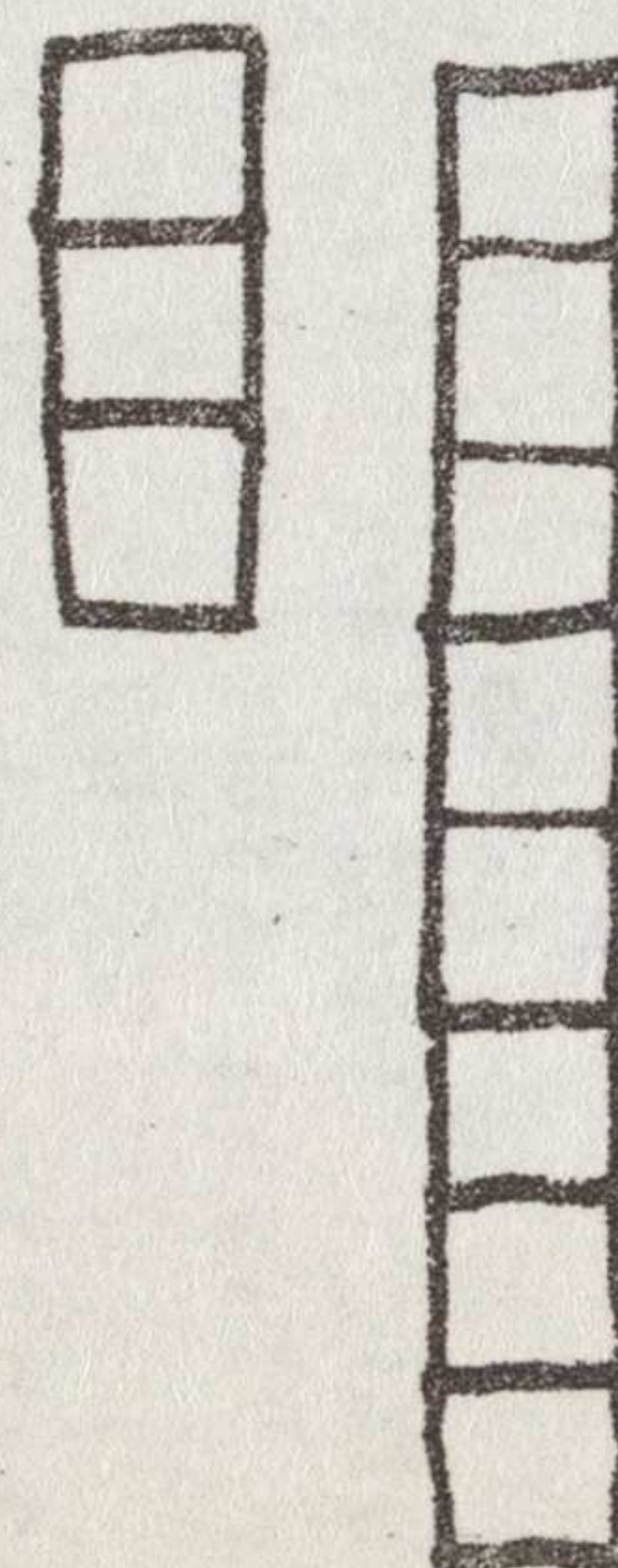
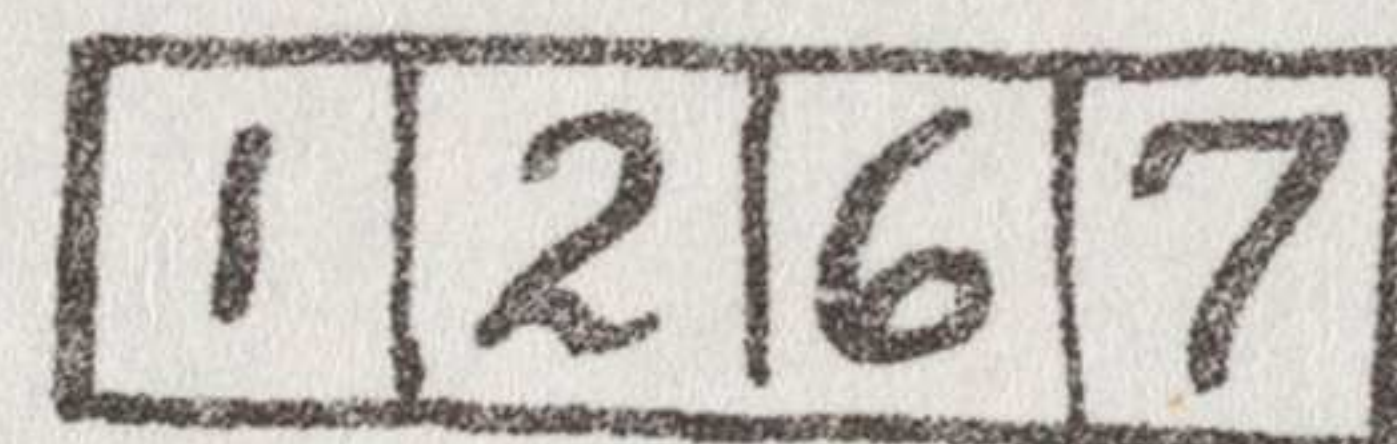
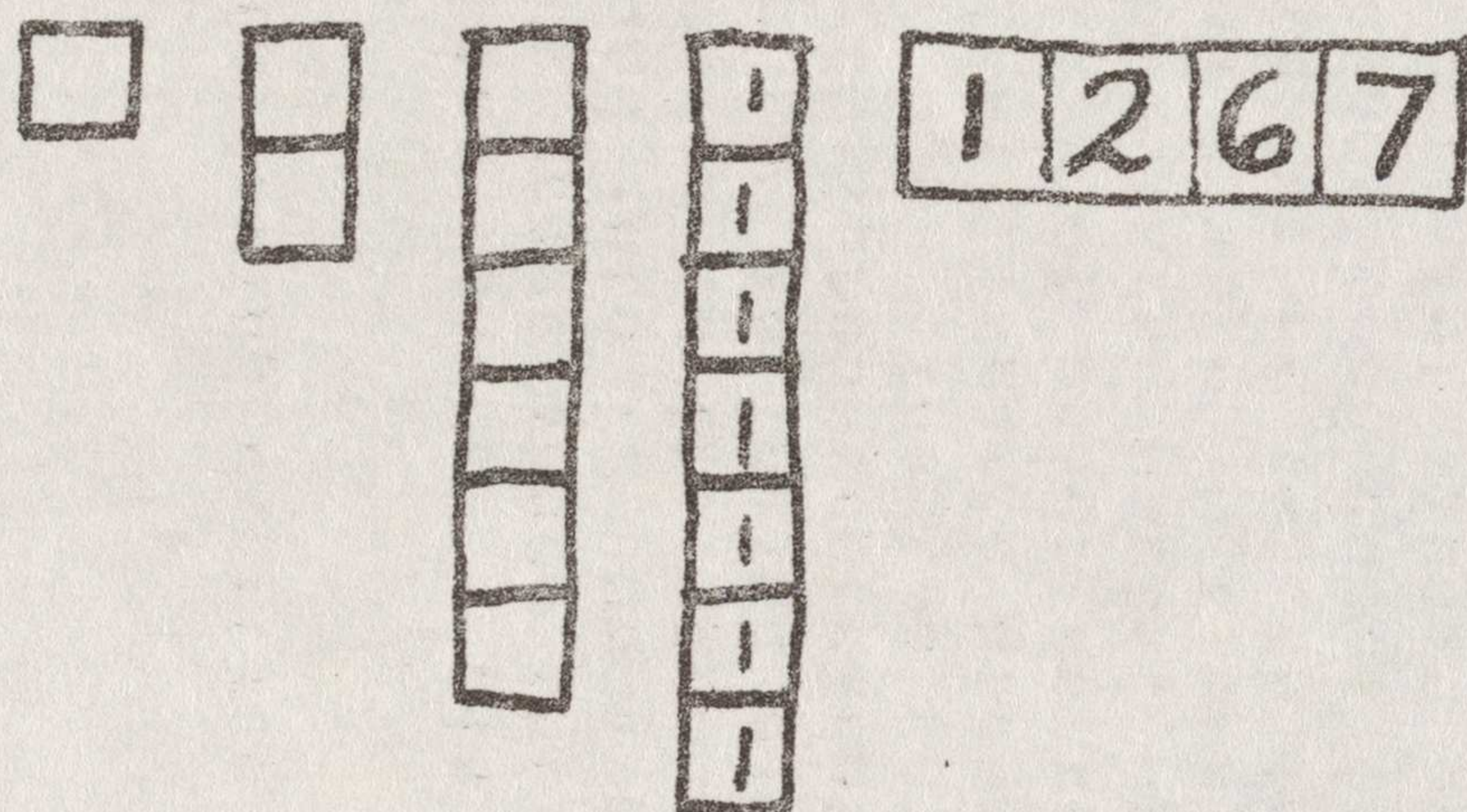
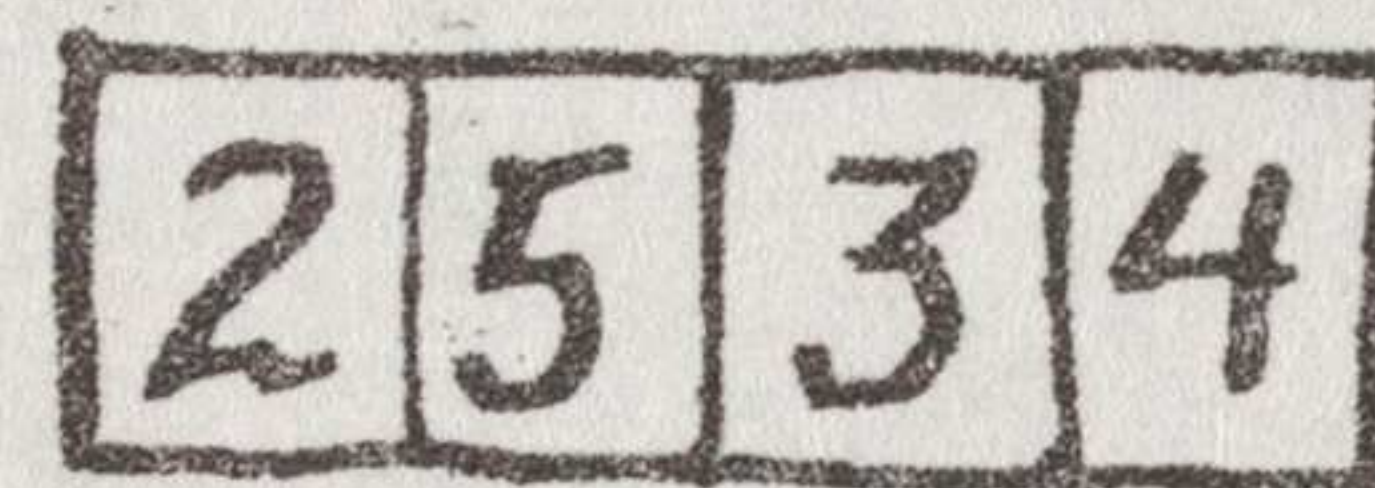
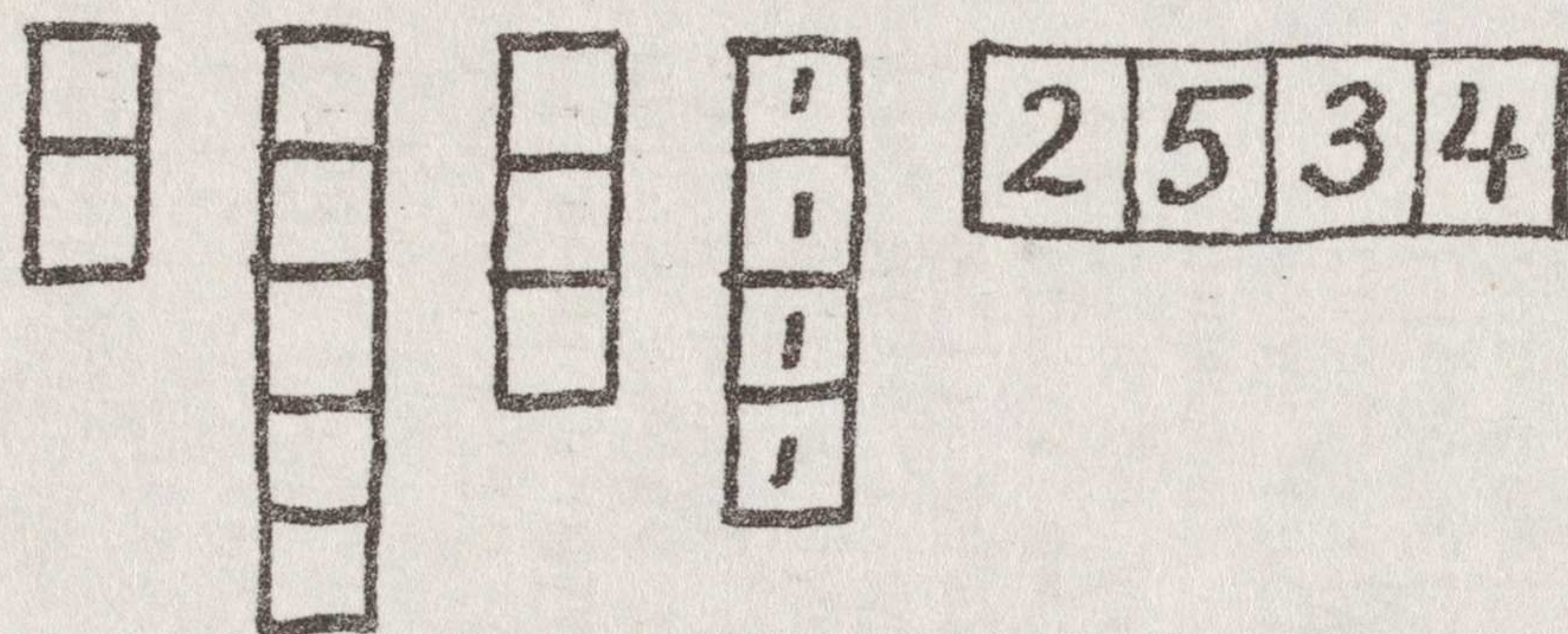
CONTROL OF ERROR

The teacher.

The Stamp Game - Addition

I

II



STAMP GAMES

MATERIAL

A box that is divided into four compartments. Each compartment contains a number of square wooden tablets referred to as stamps hereafter. The stamps differ in color and are marked by different numerals. One set of stamps is colored green and marked with the numeral 1. A second set of stamps, all of which are marked with the numeral 10, are colored blue. The third set of stamps is red and marked with the numeral 100. The fourth set of stamps is marked with 1000 and colored green.

A basket that contains 28 skittles as follows: one large green skittle and three sets of small skittles, 9 in each set, that are colored red, blue and green, respectively. The basket contains also a number of green, blue and red disks.

One set of large numeral cards - 1 through 9000. Two sets of small numeral cards - 1 through 3000.

A quantity of blank cards of the same size as the numeral cards.

A container with three colored pencils in green, blue and red and one black pencil.

Four white cards on which are printed the signs that represent the mathematical operations of addition, subtraction, multiplication and division.

A number of sheets of square-ruled paper.

DIRECT AIM

To give the child the opportunity to perform the four mathematical operations independently.

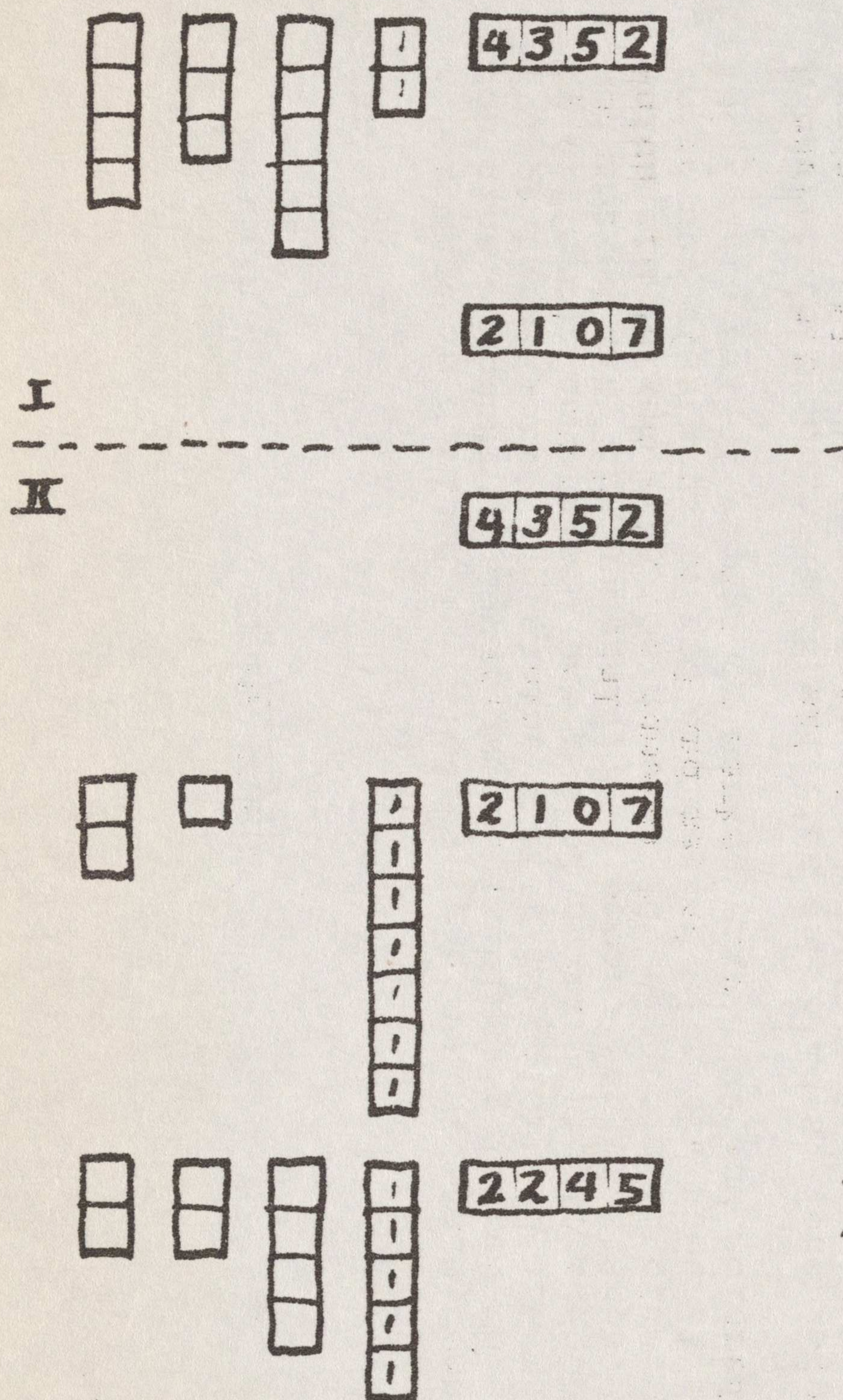
INDIRECT AIM

To develop mathematical understanding.

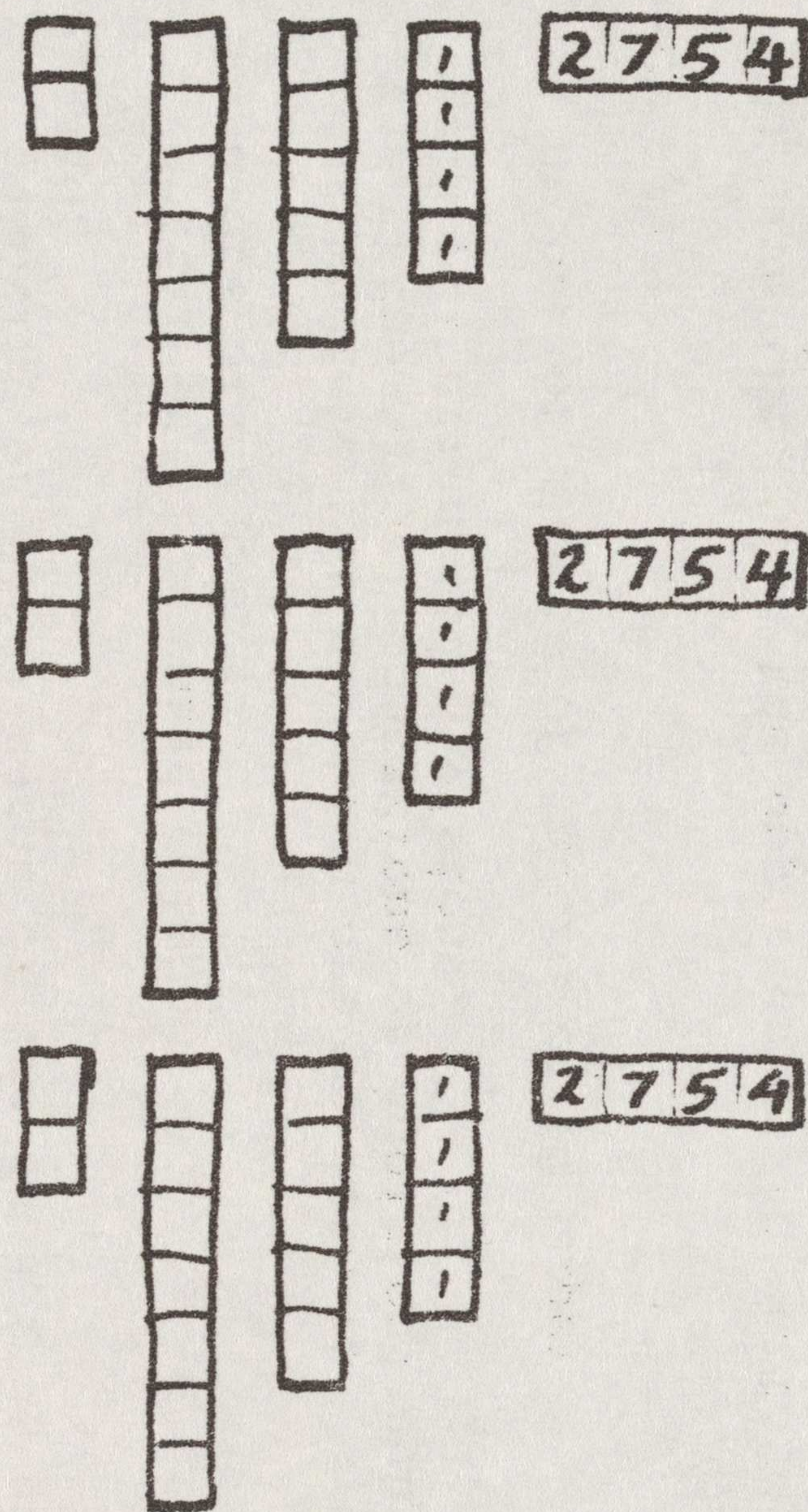
PRESENTATION

Addition

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Have him form two numerals with the small cards.
3. Then ask him to represent each numeral by the appropriate number of stamps.
4. Now show him how to combine the stamps by grouping them into columns of like numerals. Begin the grouping with the unit stamps, continue with the stamps marked with the numeral 10, and so on.



Subtraction



Multiplication

The Stamp Game ~

STAMP GAMES - CONTINUED

5. Count the stamps making exchanges as necessary.
6. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
7. Show the child the sign card for addition.

Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

SUBTRACTION

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Have him form a numeral with the large cards.
3. Then ask him to represent this numeral by the appropriate number of stamps.
4. Form a smaller numeral with the small cards.
5. Separate from the group of stamps the number of stamps indicated by the smaller numeral.
6. Count the number of stamps that remain in the original group making exchanges as necessary.
7. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
8. Show the child the sign card for subtraction.

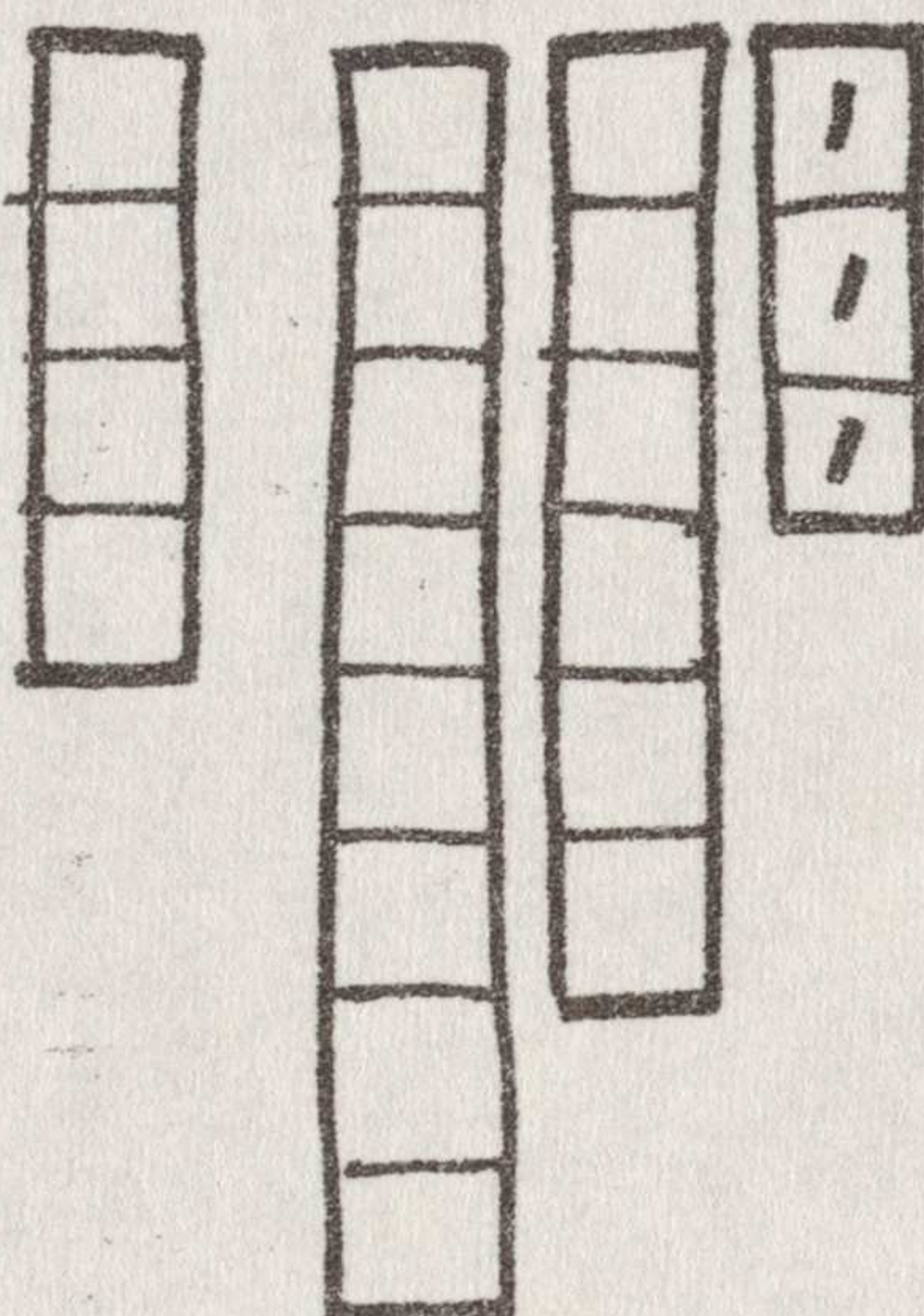
Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

MULTIPLICATION

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Form two identical numerals with the small cards.
3. Then ask him to represent each numeral by the appropriate number of stamps.
4. Now show him how to combine the stamps by grouping them into columns of like numerals. Begin the grouping with the unit stamps, continue with the stamps marked with the numeral 10, and so on.
5. Count the stamps making exchanges as necessary.
6. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
7. Show the child the sign card for multiplication.

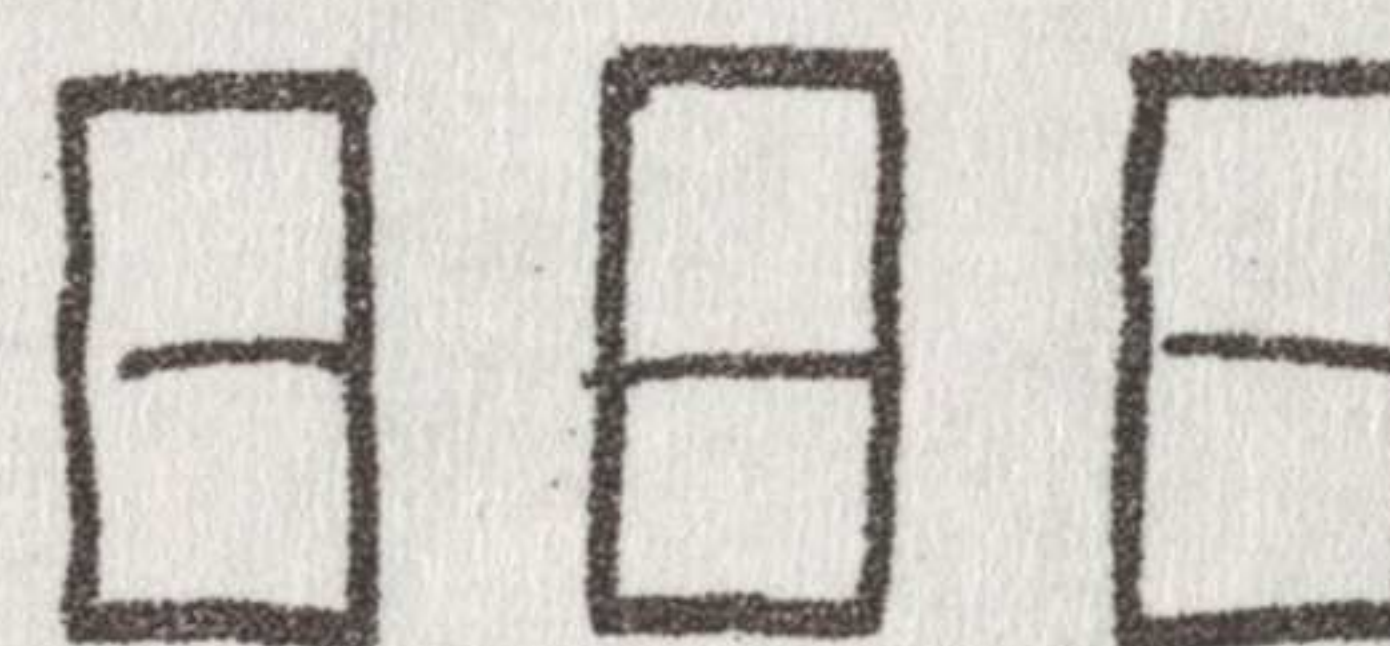
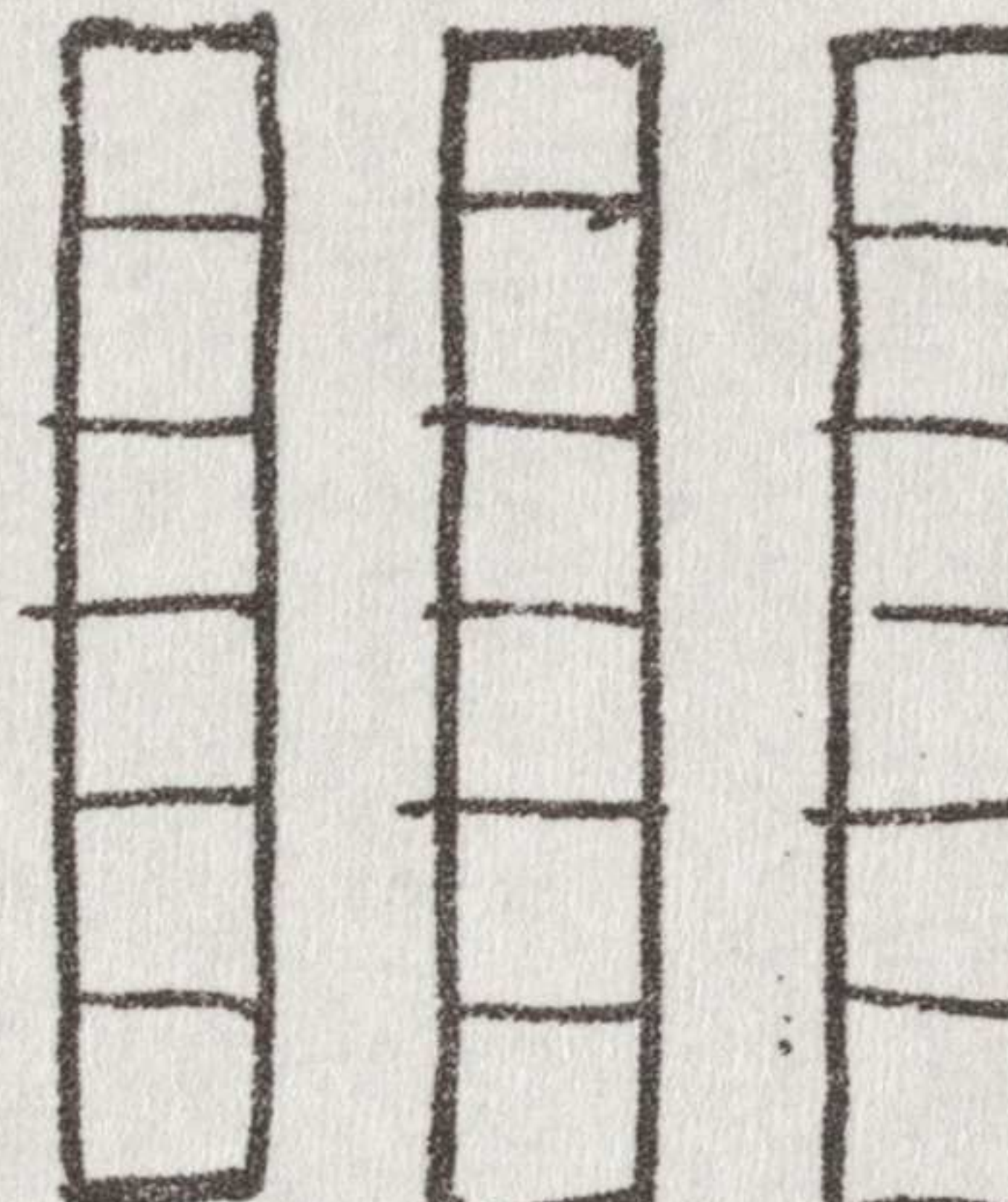
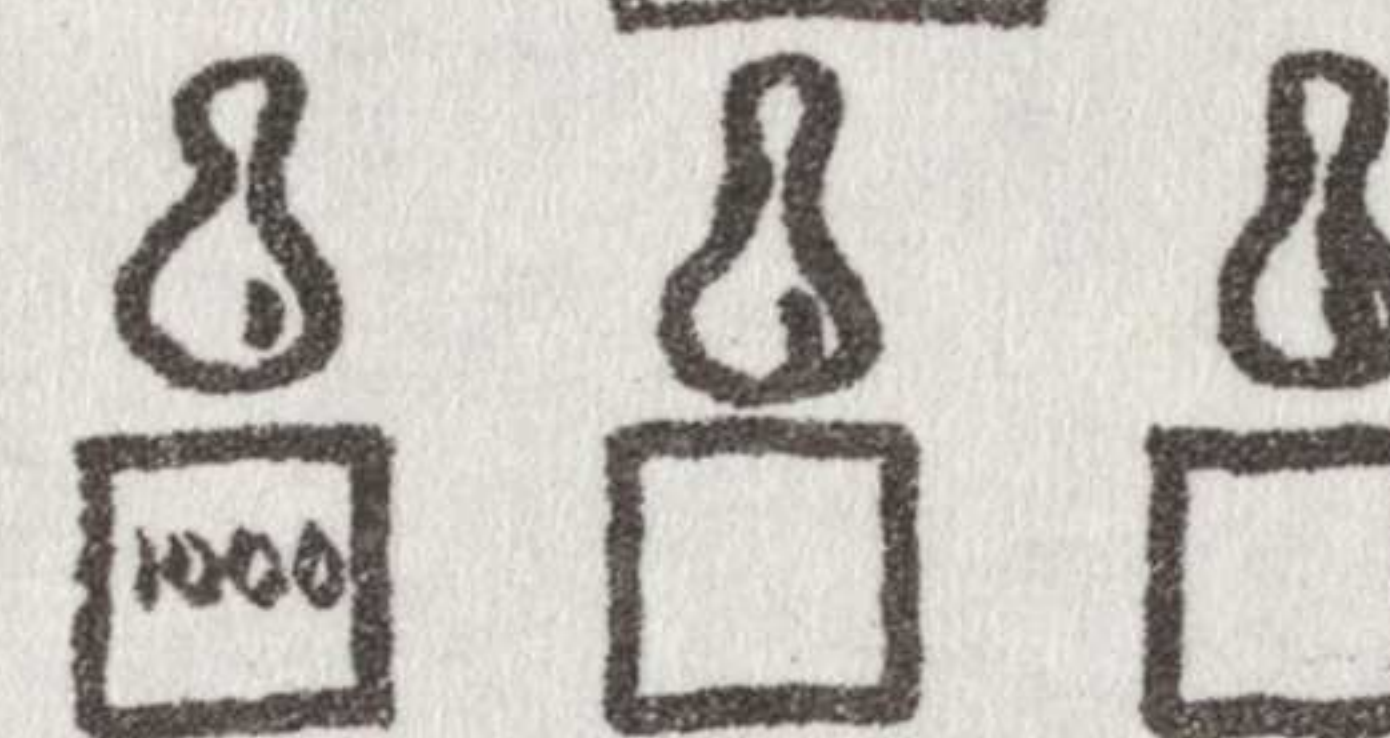
Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

4 8 6 3 $\div$ 3



I | II

4 8 6 3 $\div$ 3



1 1 1

1 6 2 1

The Stamp Game ~ Division

STAMP GAMES - CONTINUED

DIVISION

1. Ask the child to arrange the numeral cards on a table in the previously described pattern.
2. Have him form a numeral with the large cards.
3. Then ask him to represent this numeral by the appropriate number of stamps.
4. Explain that a small green skittle represents one unit, a small blue skittle represents one ten, a small red skittle one hundred and the large green skittle represents one thousand groups, respectively. Also explain that a green disk stands for zero groups in the unit place, a blue disk stands for zero groups in the ten place, a red disk for zero groups in the hundred place.
5. Select that combination of skittles that will represent the number of groups into which the stamp quantity is to be divided. Place the skittles in a row in order of their symbolic value.
6. Divide the stamp quantity so that each red skittle has 10 times the stamp quantity of a blue skittle; a blue skittle 10 times the stamp quantity of a green skittle. Start the division with the thousands. Make all necessary exchanges.
7. Count the stamp quantity distributed to any one of the small green skittles and note the remainder.
8. Ask the child to write the result on the blank cards as follows: green to denote the number of thousands and units, red for the number of hundreds and blue for the number of tens.
9. Show the child the sign card for division.

LATER EXERCISES

DIVISION

1. Show an exercise using skittles and a disk in combination.

Note: The arrangement of the material at different steps of the presentation is illustrated in the attached drawing.

FOR ALL FOUR OPERATIONS

1. Child writes all numerals and signs instead of using cards.
2. Child writes the equation for the operation.

AGE 5 to 7 years.

CONTROL OF ERROR

The teacher.

TEENS WITH BEADS

MATERIAL

Nine gold bead bars. One short bead stair constructed of nine bead bars of the following colors and number of beads:

Bar	Number of Beads	Color
1	1	red
2	2	green
3	3	pink
4	4	yellow
5	5	light blue
6	6	brown
7	7	white
8	8	lavender
9	9	dark blue

DIRECT AIM

To teach the names of the numbers 11 through 19.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Form the numbers 11 and 12 by combining one gold bar with the red bead and one gold bar with the green bar. The short bead bars are placed to the right of the gold bars.
2. Teach the names ELEVEN and TWELVE using stage 1 of the three period lesson.
3. Mix the bars and ask the child to form twelve, then eleven.
4. Mix the bars, form eleven. Ask the child to name the number. Form twelve and ask the child to name the number.

LATER EXERCISES

1. Teach the names of the teens 13 through 19 using the procedure described above.
2. Construct the numbers 11 through 19 placing them in sequential order. Ask the child to enunciate the names of the numbers in this order.

AGE 3-1/2 to 4 years.

CONTROL OF ERROR

The teacher.

TEENS WITH BOARDS

MATERIAL

Two rectangular boards divided into five and four sections, respectively. One section is separated from another by a narrow wooden ledge. The numeral 10 is printed on each of the 9 sections.

A set of nine wooden tablets, each half the width of a board, on which are printed the numerals 1 through 9.

DIRECT AIM

To teach the names of numerals 11 through 19.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Form the numerals 11 and 12 by sliding the tablets marked 1 and 2 over the zeros in the top two sections of the longer board.
2. Teach the names ELEVEN and TWELVE using stage 1 in the three period lesson.
3. Mix the tablets and ask the child to form 12, then 11.
4. Mix the tablets, form 11, ask the child to name this numeral. Form 12 and ask the child to name this numeral.

LATER EXERCISES

1. Teach the names of the numerals 13 through 19 using the procedure described above.
2. Construct the numerals 11 through 19 placing them in sequential order. Ask the child to enunciate the names of these numerals in order.

AGE 3-1/2 to 4 years.

CONTROL OF ERROR

The teacher.

Teens







1	1
1	2
1	3
1	4
1	5






1	6
1	7
1	8
1	9

TEENS WITH BEADS AND BOARDS

MATERIAL

Nine gold bead bars. A short bead stair. Teen boards and tablets.

DIRECT AIM

To associate the numbers 11 through 19 with the numerals 11 through 19.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

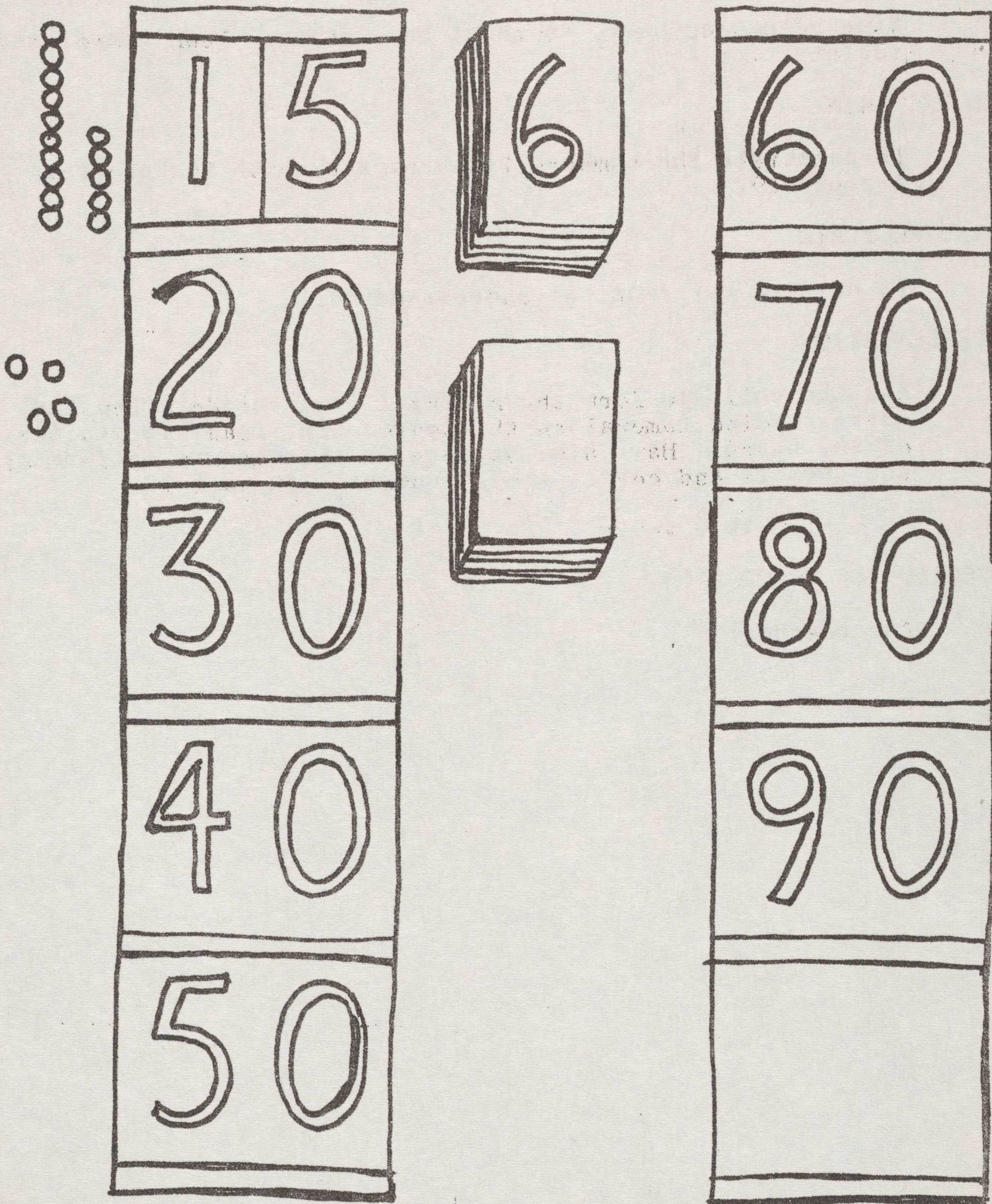
Ask the child to form the number 11 with beads, then the corresponding numeral on the board. The beads lie to the left of the board. Have him continue in this manner to form all the numbers and corresponding numerals through 19.

AGE 3-1/2 to 4 years.

CONTROL OF ERROR

The teacher.

Tens



TENS WITH BEADS AND BOARDS

MATERIAL

45 gold bead bars and 10 gold beads. Two rectangular boards divided into five and four sections, respectively. One section is separated from another by a narrow wooden ledge. The numerals 10 through 90 are printed on the nine sections. A set of 9 wooden tablets, each half the width of a board, on which are printed the numerals 1 through 9.

DIRECT AIM

1. To teach the names 20, 30, 90.
2. To associate these numbers with the corresponding numerals.
3. To teach counting from 10 through 90.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

WITH BEADS:

1. Form the numbers 20 and 30 using the gold bead bars. Teach the names TWENTY and THIRTY using stage 1 in the three period lesson.
2. Mix the bars and ask the child to form 30 then 20.
3. Ask the child to name the numbers 20 and 30.
4. As later exercises, teach the names of the numbers 40 through 90 following the above procedure.

WITH BOARDS:

1. Teach the names of the numerals 20 and 30 using the three period lesson.
2. As later exercises, teach the names of the numerals 40 through 90 using the three period lesson.

WITH BEADS AND BOARDS:

Ask the child to form the number 10 with beads and place it to the left of the corresponding numeral on the board. Have him continue in this manner until all the numbers corresponding to the numerals on the boards have been formed.

LATER EXERCISES

Form all the numbers 11 through 99, using bead bars and single beads, and the corresponding numerals, using the boards and tablets. Form these numbers and numerals in sequential order. Form 20 employing one bar and all 10 loose beads. Before proceeding to form 21, replace the 10 loose beads with one bead bar moving the two bead bars to the left of 20 on the board. Proceed in like manner to replace loose beads by a bar before forming 31, 41 ... 91.

AGE 3-1/2 to 4-1/2 years.

CONTROL OF ERROR The teacher.

CHAIN OF 100

MATERIAL

Ten bead bars, of 10 beads each, linked to form a chain. A bead square made of 10 bead bars. A red envelope containing three sets of labels with each label pointed at one end. One set of 9 green labels on which are printed the numerals 1 through 9; one set of 9 blue labels on which are printed the numerals 10, 20....., 90; and one red label on which is printed the numeral 100. The sets of 9 labels each are held together by rubber bands.

Long rolls of square-ruled paper about 2 inches wide and lead pencils.

DIRECT AIM

To show the child the square of ten.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Place the labels on a rug and order them in numerical sequence.
2. Arrange the chain in a straight line on the floor.
3. Fold the chain to form a square.
4. Compare this square with the other bead square.
5. Unfold the chain so that it lies in a straight line with the bead square at one end of the chain.
6. Ask the child to assist you in counting the number of beads in the chain. Begin counting from the end of the chain that lies away from the bead square. Place the green labels in numerical sequence to the right of the first 9 beads with the pointed ends touching the beads. Place the blue label that is marked with the numeral 10 to the right of the 10th bead, the blue label marked 20 to the right of the 20th bead, and so on to 90. Place the red label to the right of the 100th bead.
7. Ask the child to count the chain in tens by reading the blue and red labels.

NOTE: Emphasize that the chain contains ten tens or one hundred beads and can be made to form a square with ten beads to a side.

LATER EXERCISE

Ask the child to write on a long roll of square-ruled paper all the numerals in their proper sequence from 1 to 100.

CHAIN OF 1000

MATERIAL

One hundred bead bars of 10 beads each, linked to form a chain. Each 100 beads are separated from another 100 by a double link. Ten bead squares, each made of 10 bead bars. One bead cube made of 10 bead squares. A green envelope containing four sets of labels, with each label pointed at one end. One set of 9 green labels on which are printed the numerals 1 through 9; one set of 9 blue labels on which are printed the numerals 10, 20,, 90; one set of 90 red labels on which are printed the numerals 100, 110, 000, 200, 210, 0000, 900; and one green label on which is printed 1000.

Long rolls of square-ruled paper about 2 inches wide and lead pencils.

DIRECT AIM

To show the child the structure of the CUBE of ten.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Place the labels on a rug and order them in numerical sequence.
2. If possible, arrange the chain in a straight line on the floor.
3. Fold the chain to form ten squares.
4. Place on top of each of these squares one of the other bead squares. Use the latter bead squares to form a cube. Compare the cube just formed with the other bead cube.
5. Unfold the chain so that it lies with the bead cube at one end of the chain.
6. Ask the child to assist you in counting the number of beads in the chain.
7. Begin counting from the end of the chain that lies away from the bead cube. Place the labels in numerical sequence to the right of the beads.
8. Ask the child to count the chain in tens by reading the blue and red labels and green label marked 1000.

NOTE: Emphasize that the cube of ten has ten beads to a side and contains one thousand beads.

LATER EXERCISES

1. Compare this chain with the chain of 100 beads by placing them alongside each other.
2. Ask the child to write on a long roll of square-ruled paper all the numerals in their proper sequence 1 to 1000.

AGE 4 to 5-1/5 years

CONTROL OF ERROR

The teacher.

BEAD CHAINS OF VARYING LENGTH

MATERIAL

A number of bead chains, each of which when folded will form bead squares that represent the quantities 1^2 , 2^2 , 3^2 ,, 9^2 .

A number of bead chains, each of which when folded will form the number of bead squares necessary for construction of bead cubes that represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

A series of bead squares. Each series contains the number and size of squares that are necessary to construct the bead cubes that will represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

A number of bead cubes to represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

A number of bead cubes to represent the quantities 1^3 , 2^3 , 3^3 ,, 9^3 .

The colors of the beads that compose the chains, squares and cubes vary with quantities represented as follows:

<u>Quantity</u>	<u>Color</u>
1	red
2	green
3	pink
4	yellow
5	light blue
6	brown
7	white
8	lavender
9	dark blue

For every section in a chain there is a label marked with the numeral that represents the quantity of beads in that section. Every label is of the same color as the beads in the section that it belongs to.

A small card, made of cardboard and provided with a notch, that is to be used in counting.

DIRECT AIM

To show the difference in quantities between the squares and cubes of the numbers 1, 2,, 9 by counting beads.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Select any number between 1 and 9, inclusively, and bring the chains, squares, the cube and the labels that are of the corresponding color.

BEAD CHAINS OF VARYING LENGTH - CONTINUED

2. Place the labels for each chain in numerical sequence.
3. Arrange each chain in a straight line so that a comparison of their length can be made.
4. Fold the shorter chain to form a square. Superimpose a bead square on this formation to show that both have the same quantity of beads.
5. Unfold the chain to form again a straight line.
6. Ask the child to count the beads in the chain by using the notched card. As he is counting, have him place the appropriate label at the end of every section and to the right of it.
7. Fold the longer chain to form a number of squares. Superimpose a bead square on each formation to show that they have the same quantity of beads.
8. Remove the bead squares and form a cube from them. Compare this formation with the bead cube.
9. Unfold the chain to form again a straight line.
10. Ask the child to count the beads in the chain. As he is counting have him place the appropriate label at the end of every section and to the right of it.
11. Ask the child to count the number of beads in the shorter chain by having him enunciate the numerals that are printed on the labels. Ask him to count the number of beads in the longer chain in the same manner.

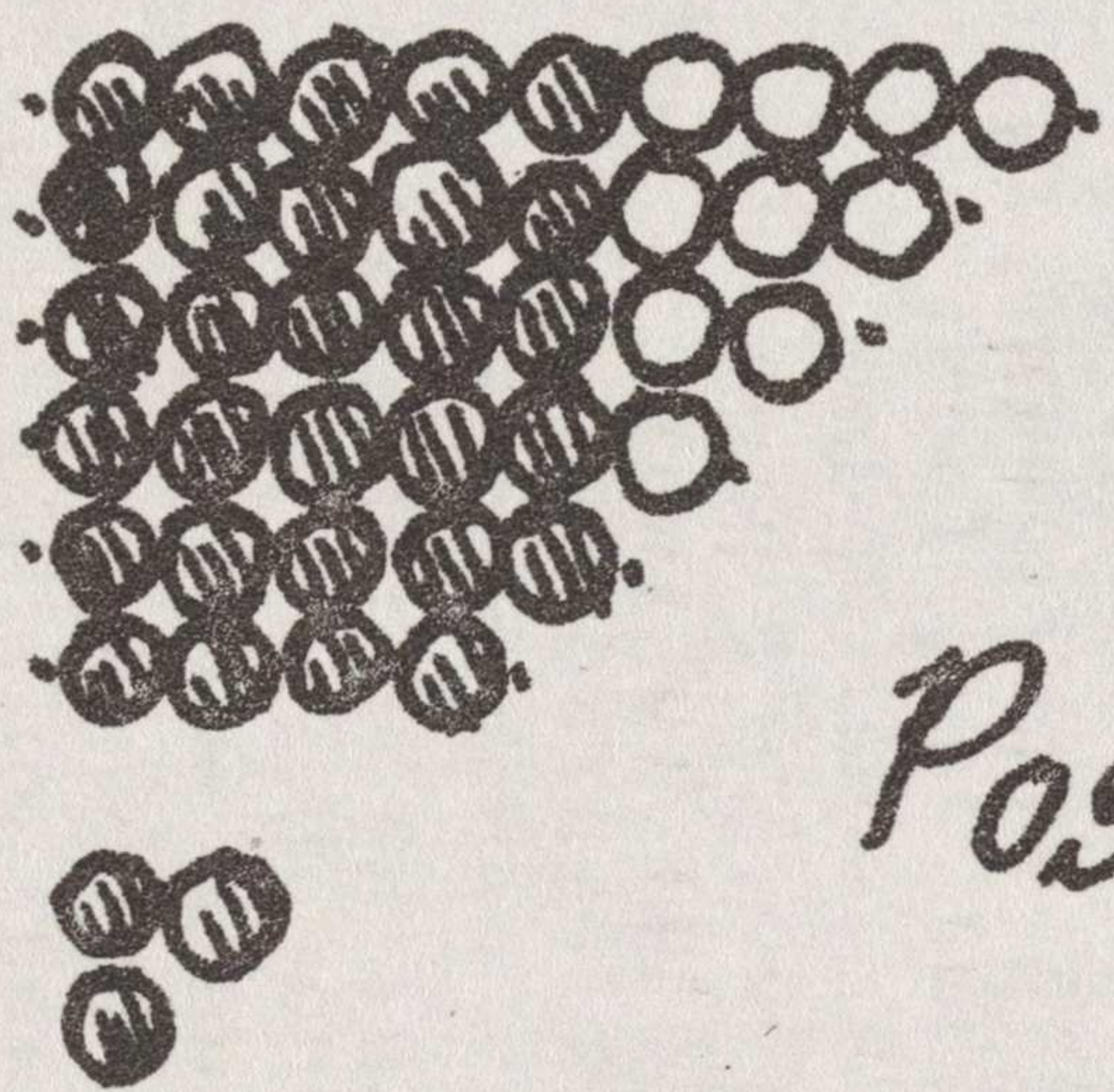
NOTE: Emphasize the structure of the square of a number and
 LATER EXERCISES of the cube of a number.

1. Have the child repeat the exercise in the above described manner for each number in the series 1 through 9.
2. Arrange all the shorter chains in order of length by placing the first bead in each chain along a horizontal straight line.
3. Arrange the longer chains in the same manner.

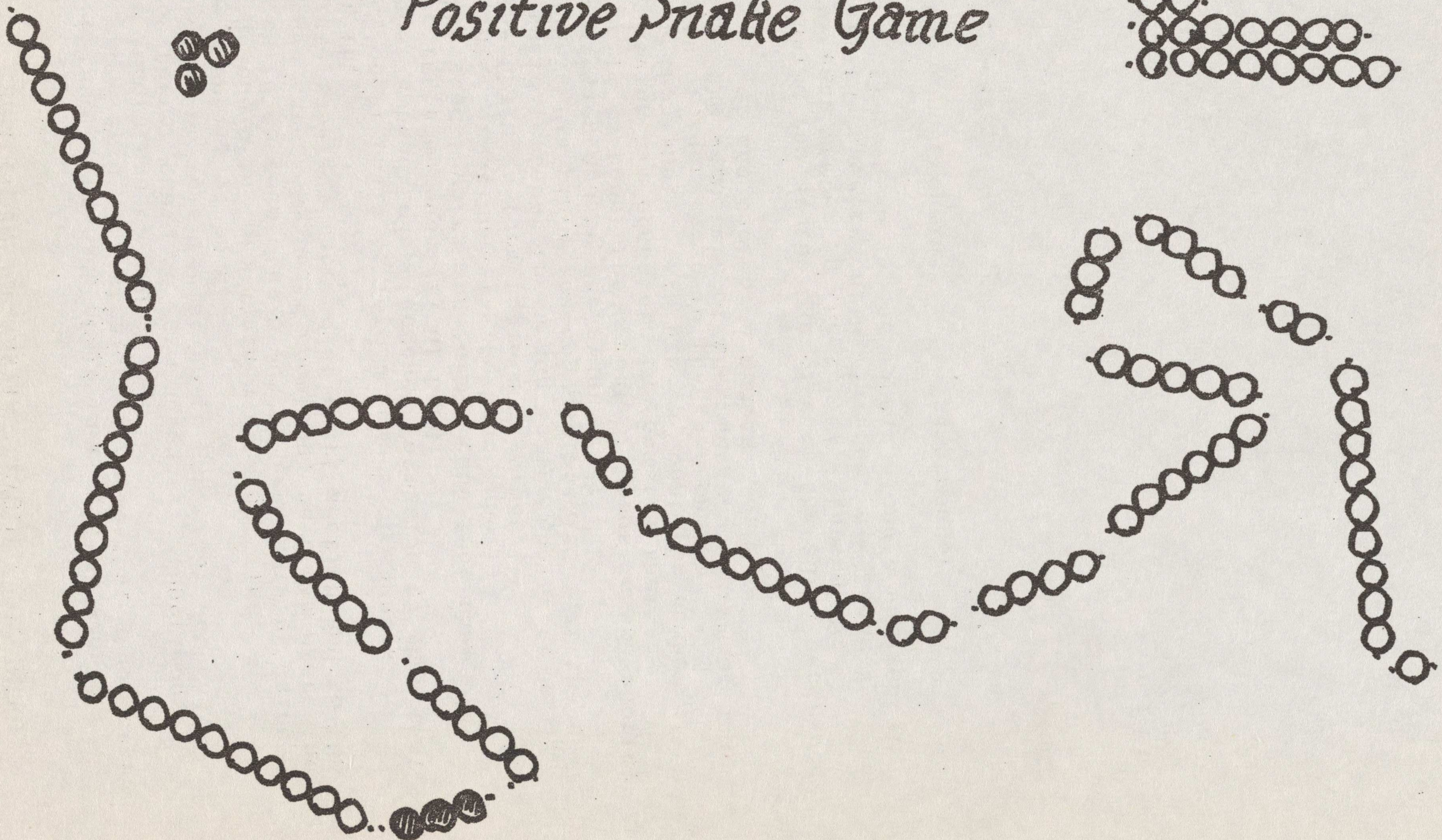
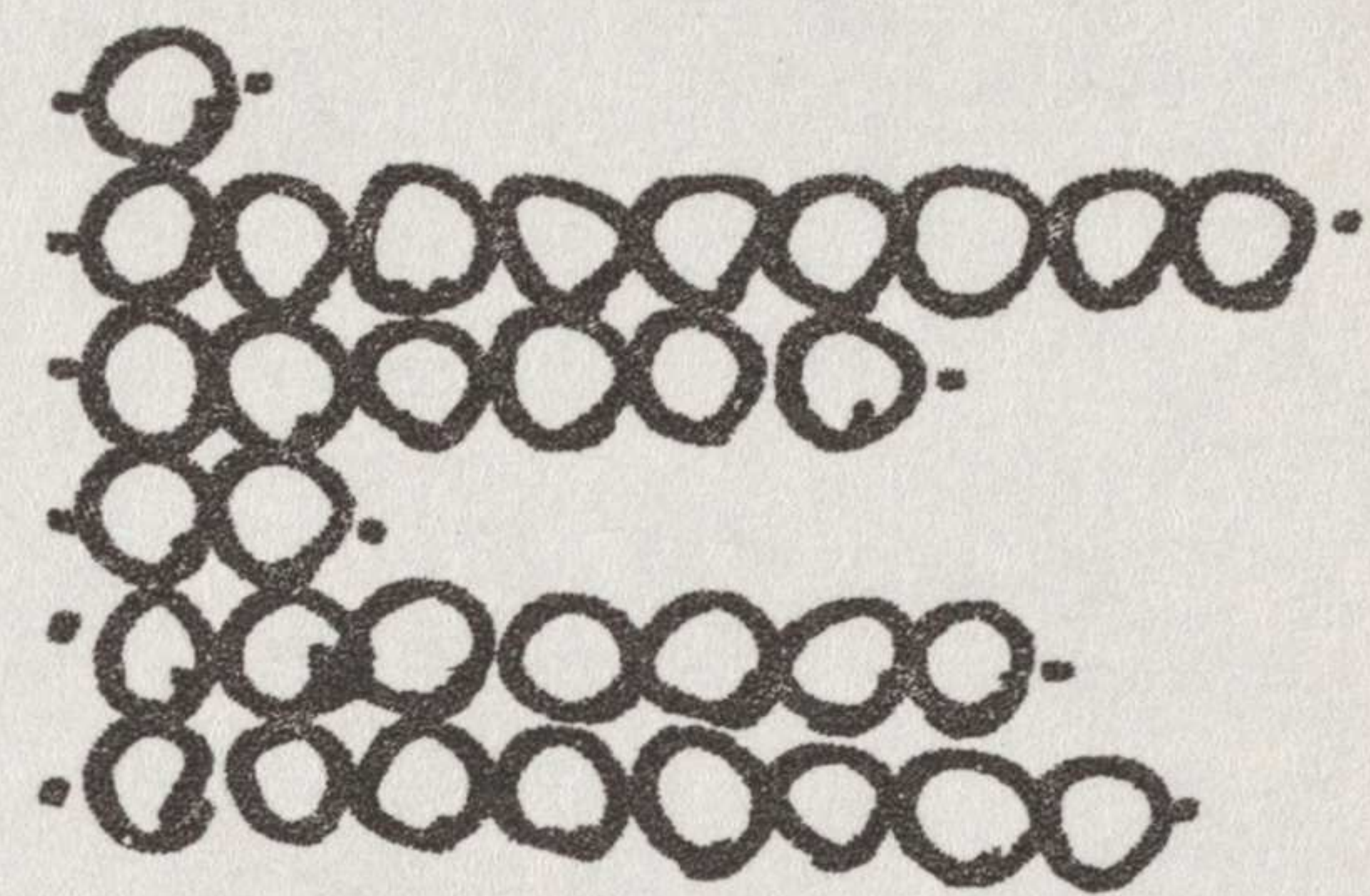
AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The teacher.



Positive Snake Game



SNAKE GAME

MATERIAL

- A number of colored short bead stairs in a wooden box.
- A number of bead strirs each composed of nine bead bars.
- The bars that have 5 or less beads are colored black.
- The bars that have more than five beads are colored black and white, with the number of black beads always 5.
- A number of gold bead bars of 10 beads each.
- A bead square composed of 10 gold bead bars.
- A small notched card.

DIRECT AIM

To perform the operation of addition on numbers less than 10 as an introduction to the addition table.

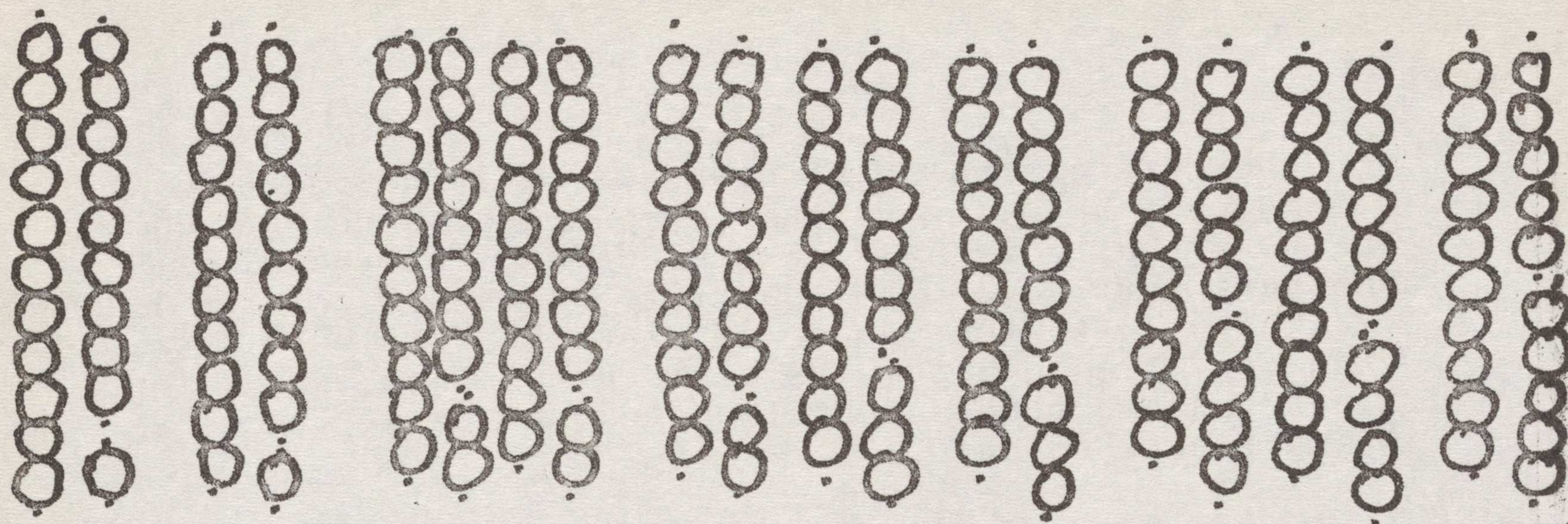
INDIRECT AIM

To develop mathematical understanding.

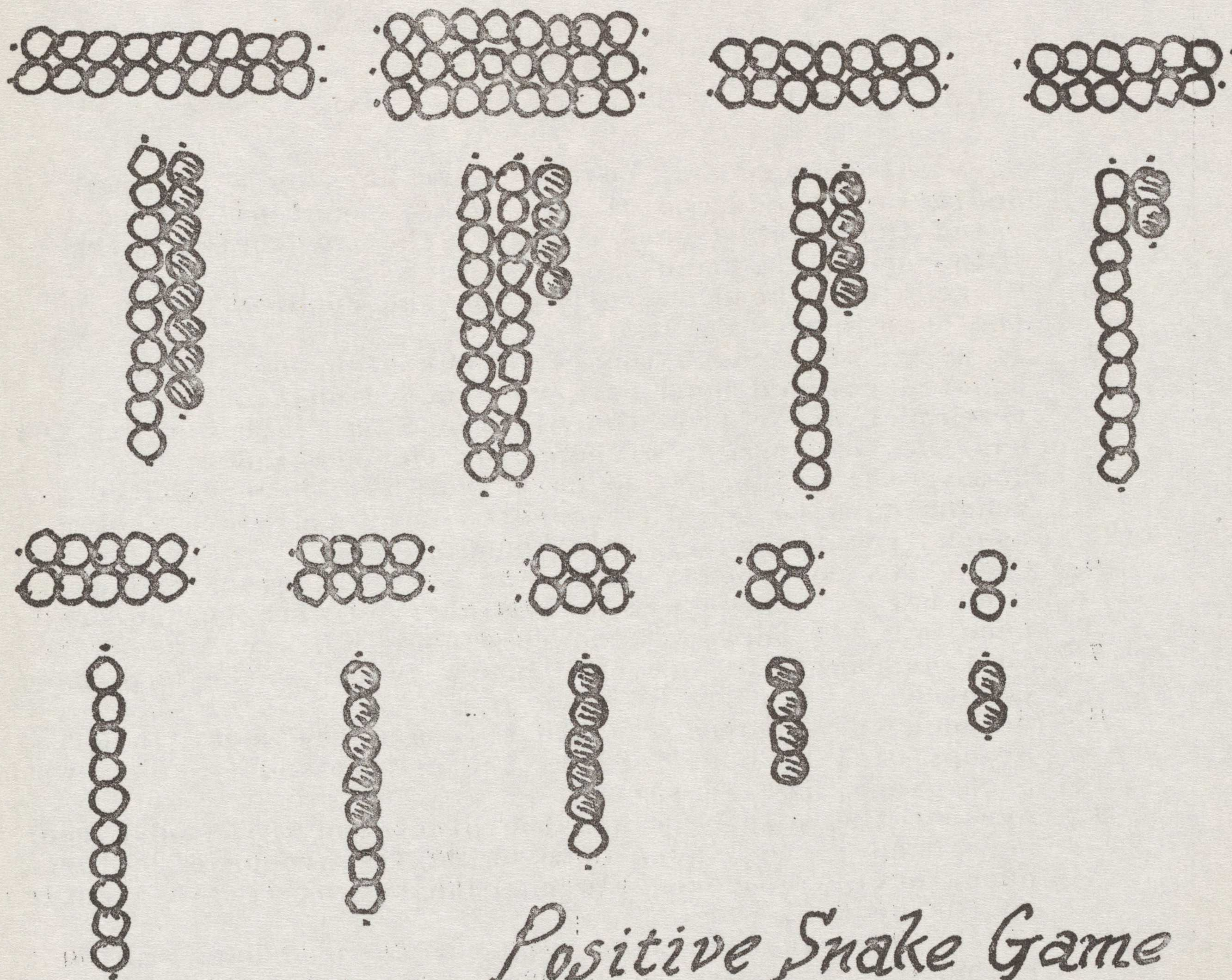
PRESENTATION

1. Form a long snake of colored bead bars on a felt mat.
2. Beginning at one end of the snake, count off 10 beads using the notched card. Insert the card between the 10th. and 11th. beads.
3. Place a gold bead bar alongside the counted beads in the bead snake.
4. If necessary, count the remainder of beads in the partly-counted colored bead bar and place alongside this remainder a bar from the black and white bead stair that has the same number of beads as the remainder.
5. Remove the colored bead bars that have been counted, beginning with the last counted bar, and place them apart from the material at hand.
6. Count ten more beads beginning with the black and white bead bar, if there was a remainder or with the colored bead bar, if there was no remainder. Proceed as above.
7. Continue until all colored beads in the snake have been counted.
8. Arrange the colored bars that formed the snake into groups of like bars. Place the groups and the bars within each group, horizontally.
9. Arrange the gold bars and the black and white bars that were used in the snake game below the groups of colored bars leaving a space between each bar as it lies vertically to the groups.
10. Match the gold bead bars with the colored bars making all exchanges necessary for a one-to-one matching. Place the colored bars alongside the gold bars.

Verification I



Verification II



Positive Snake Game

SNAKE GAME - CONTINUED

NOTE: A one-to-one matching will only be possible if no mistakes were made in the counting.

LATER EXERCISES

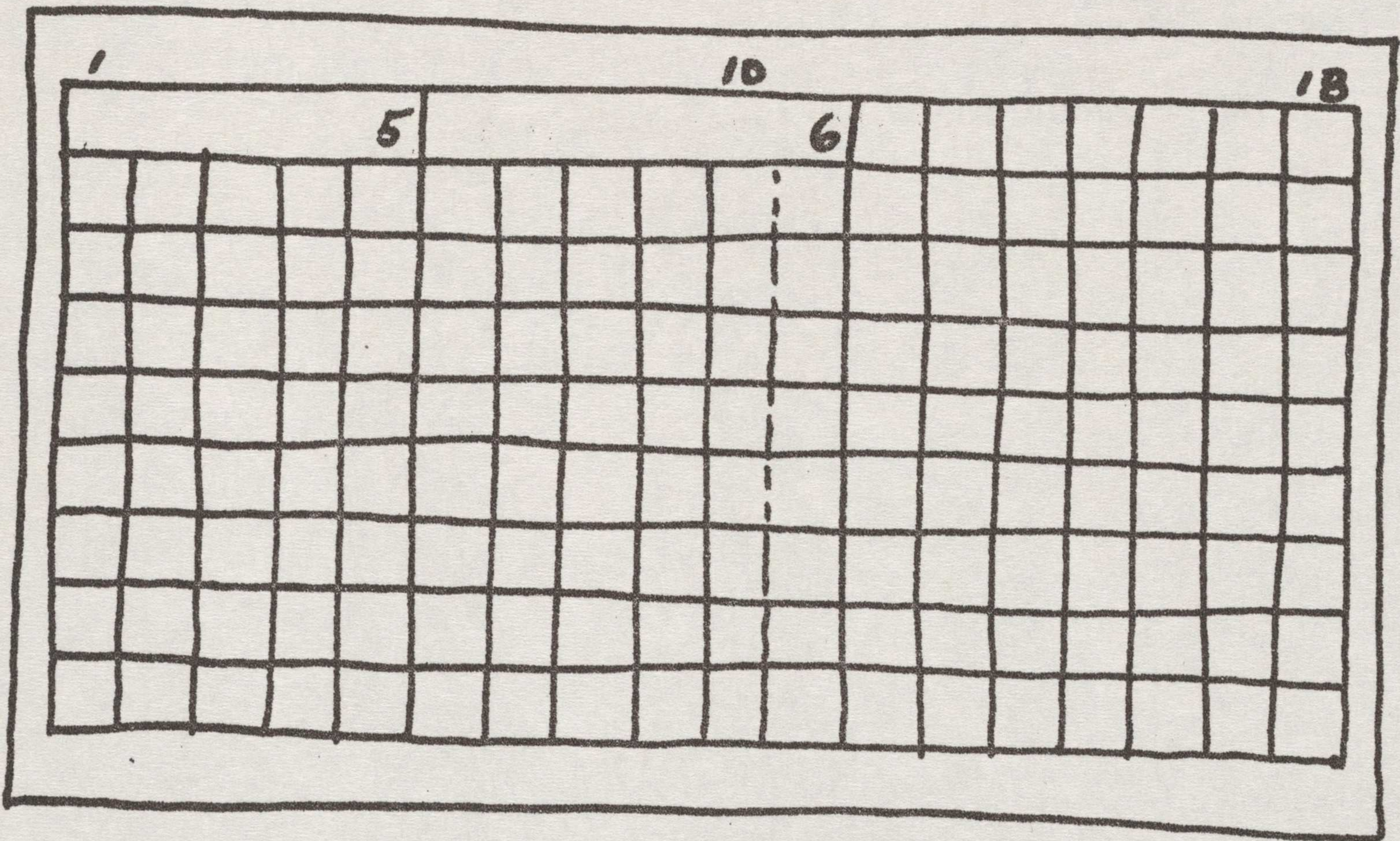
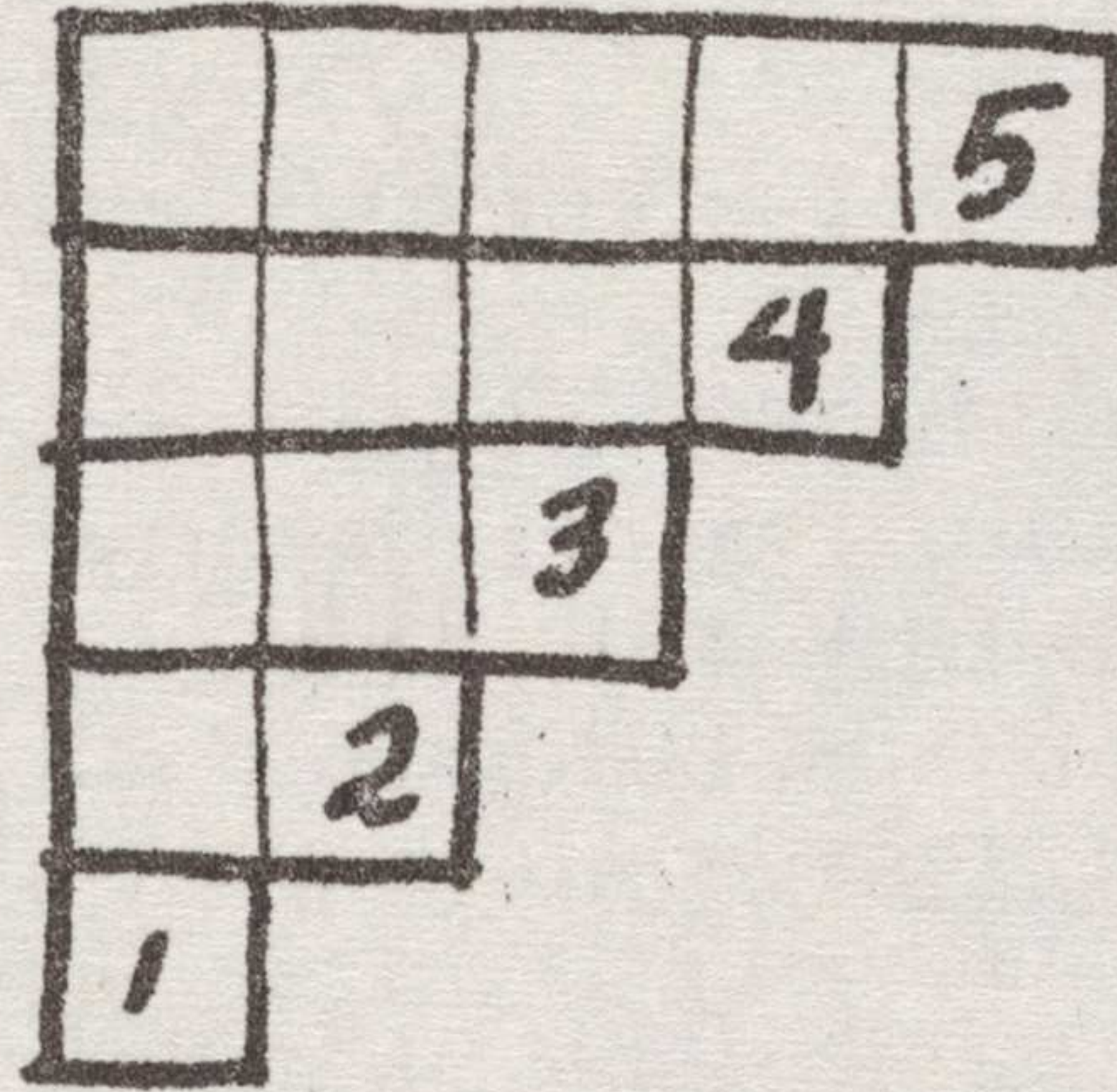
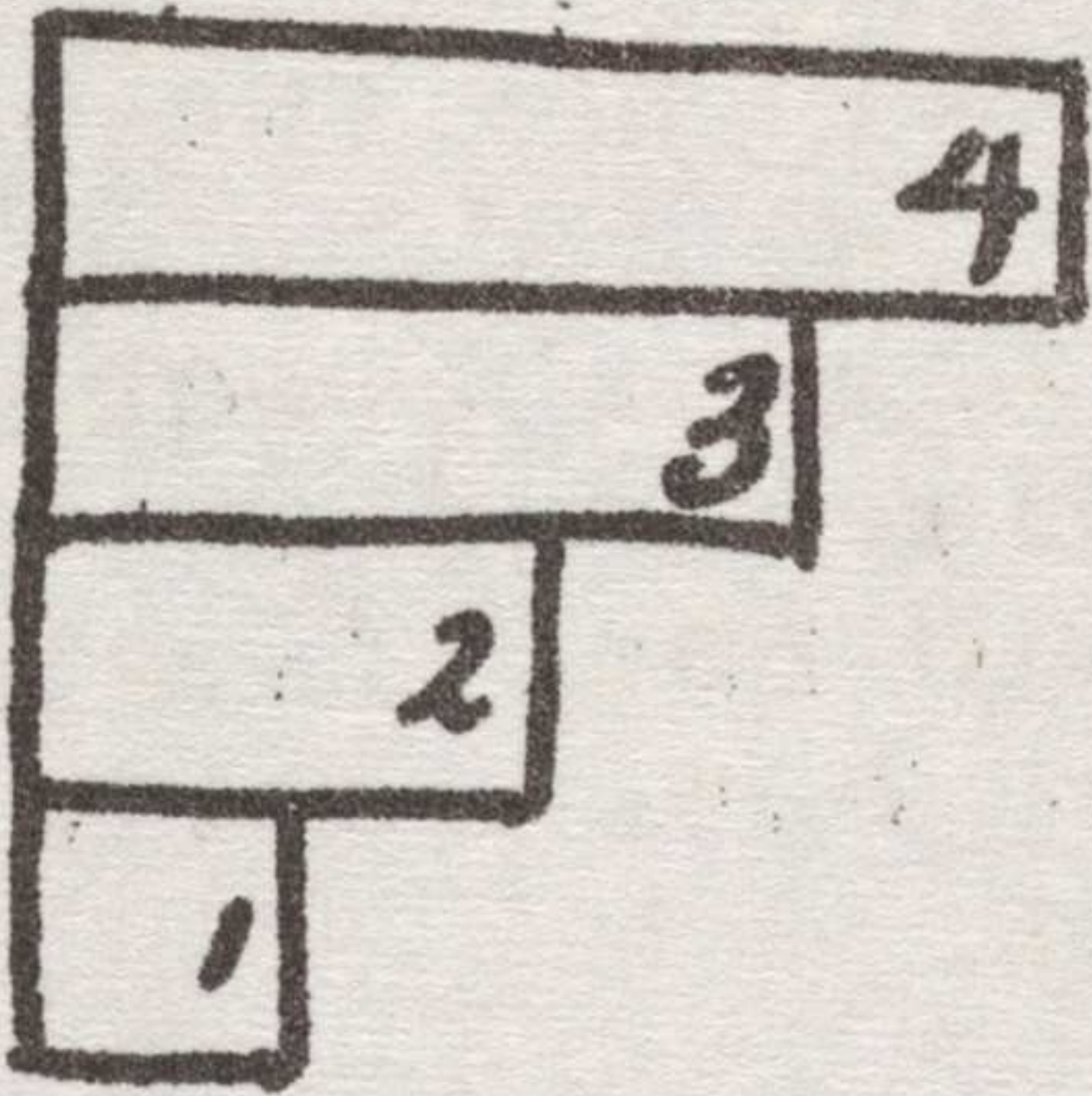
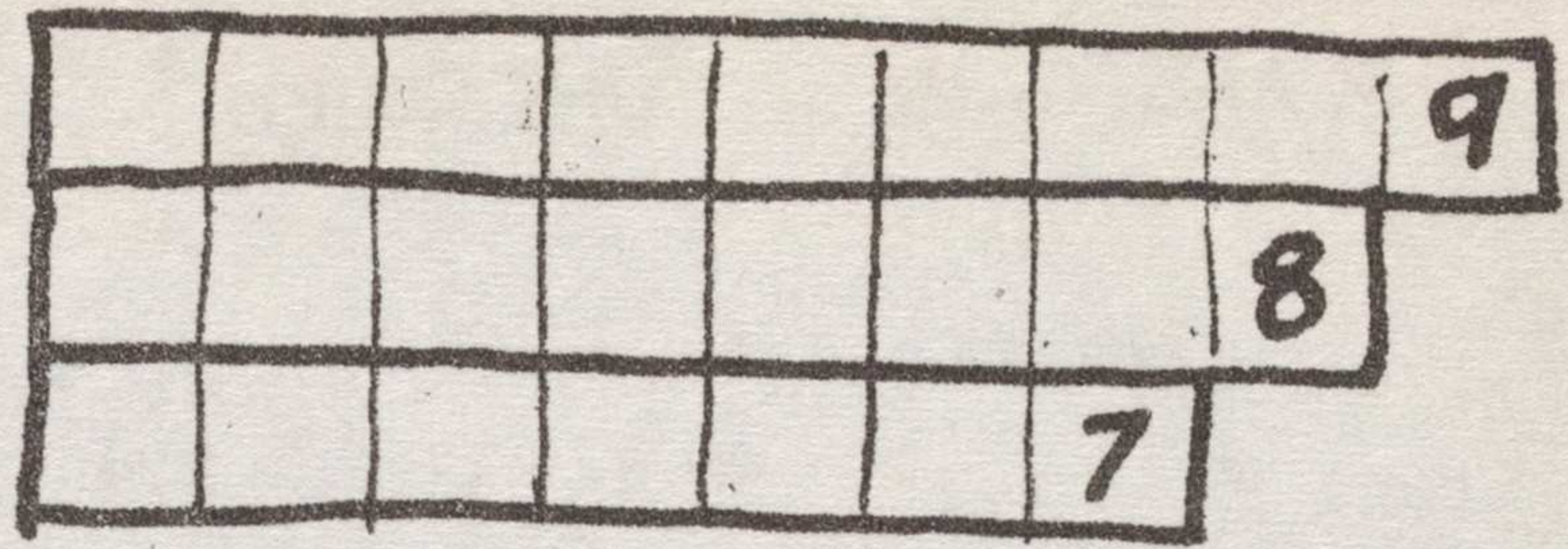
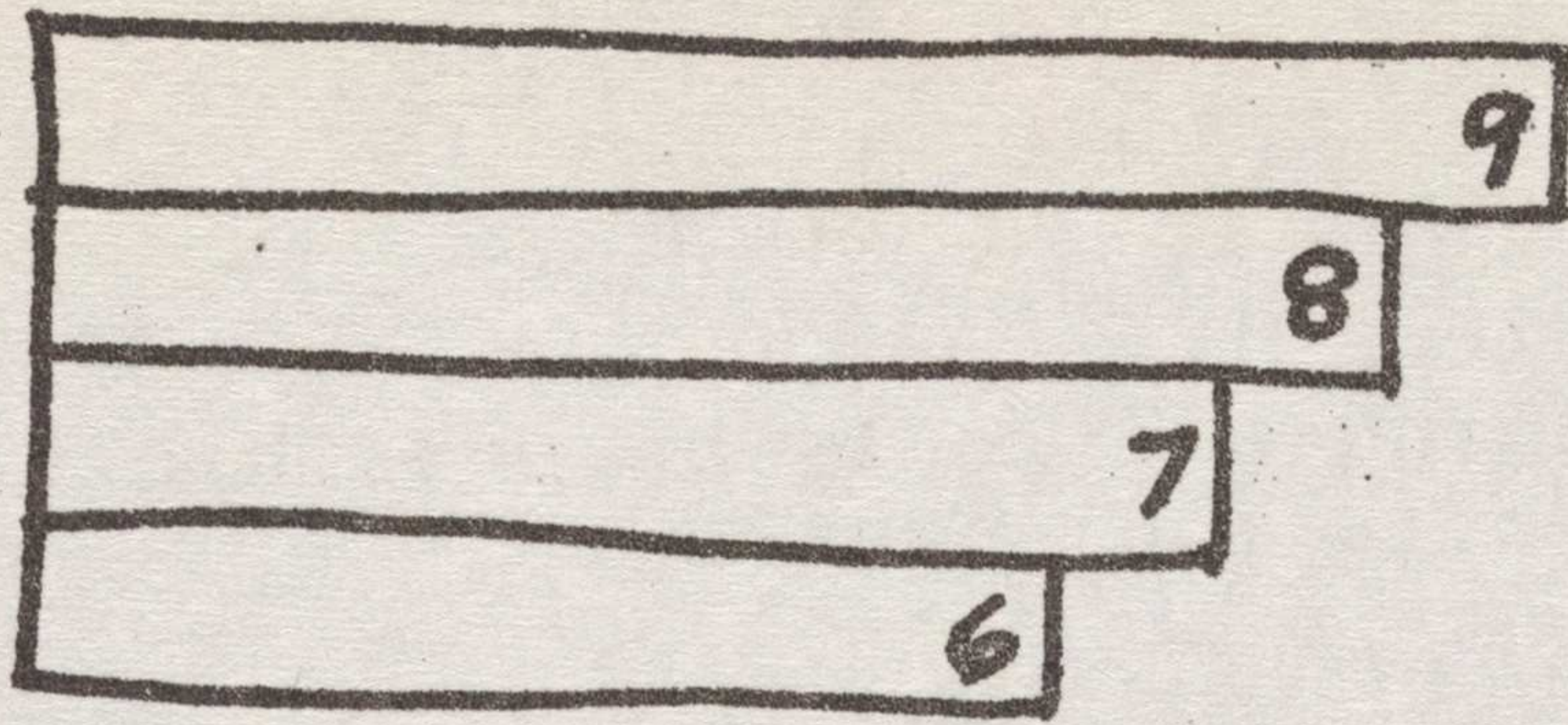
Instead of steps 8 and 9 as described above, do the matching as follows:

Arrange below each group of colored bars the equivalent quantity of beads in gold bars and black and white bars, making the necessary exchanges of gold bars for black and white bars. Place the equivalent bars vertically to the group of colored bars above it.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The teacher and the final matching.



Addition Strip Board



	5	
5+1=		6
5+2=		7
5+3=		8
5+4=		9
5+5=		10
+6=		
+7=		
+8=		
+9=		

STRIP BOARD - ADDITION

MATERIAL

Rectangular wooden board with the numerals 1 to 10 printed in red and the numerals 11 to 18 printed in black across the top as columnar headings. The board is divided into 2 cm squares - 9 down and 18 across. Columns 10 and 11 are separated by a heavy line.

A set of blue wooden strips, 2cm wide and from 2cm to 18cm long. Each strip has one of the numerals 1 to 9 printed at the right end. The shortest strip has the numeral 1 and the longest the numeral 9 printed on it.

A set of red wooden strips, 2cm wide and from 2cm to 18cm long. Each strip is divided into 2cm squares and has one of the numerals 1 to 9 printed in the right end square. The shortest strip has the numeral 1 and the longest has the numeral 18.

A set of 18 blank unpainted wooden strips, 2cm wide and from 2cm to 36cm long.

A number of slips of paper each of which looks as follows:

+1=
+2=
+3=
+4=
+5=
+6=
+7=
+8=
+9=

Chart 1 is an addition table of all possible permutations of the numbers 1 through 9, taken two at a time. The sums of 10 are printed in red along the positive sloped diagonal.

Chart 2 is an addition table that shows the sums for all combinations of the numbers 1 through 9, taken two at a time. The sums of 10 are printed in red along the horizontal divider of the table.

DIRECT AIM

To construct the above described addition tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Arrange the strips of each set in numerical sequence.
2. Place the blue strip marked with the numeral 1 in the first row of the first column on the wooden board. Place the

STRIP BOARD - ADDITION - CONTINUED

- red strip marked with the numeral 1 in the first row of the second column. Read the result of the addition $1+1$ in the square above the numeral on the red strip.
3. Continue replacing the red strips to form the sum $1+2$, $1+3$, $1+4$,, $1+9$. In each case, read the result of the addition in the square above the numeral on the red strip.
 4. Repeat the exercise recording the first addend and the result of each addition on the slip of paper provided for this purpose.
 5. Check the results against chart 1.

LATER EXERCISE

1. Ask the child to form all sums using as first addend 2, then 3 then 9. Have him record the result of each addition as before.
2. Select a sum not greater than 18 and from all possible permutations of two numbers that will add to this sum. After selecting the sum, place the blank strip on the numbered row of the board so that all numerals to the right of the selected sum are masked. Record both addends and the sum for every permutation.
3. Show the child that addition is a commutative operation.
4. Have the child record all possible combinations of two numbers that form a given sum not greater than 18. Check the results against chart 2.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Charts 1 and 2 and the teacher.

CHARTS - ADDITION

MATERIAL

Three addition tables and one blind chart as illustrated by N. Newkirk. Throughout this exercise, these will be referred to as chart 3, 4, and 5. The blind chart will be referred to by this name. Charts 1 and 2, referred to in the previous exercise, will serve as control devices.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of chart 3. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written all possible permutations, taken two at a time of the numbers 1 to 9, with a plus sign between any two numbers and an equal sign after the second addend. The results of the additions are not given. There is one slip of paper for each permutation.

A second basket containing folded slips of paper on which are written all possible combinations, taken two at a time, of the numbers 1 to 9, with a plus sign between any two numbers and an equal sign after the second addend. In every combination the first addend is smaller than or equal to the second addend. There is one slip of paper for each combination.

Pencils and square-ruled paper.

DIRECT AIM

To use various forms of addition tables in order to have the child memorize the results of the addition operations that are contained in these tablets.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Have the child pick a slip of paper from the first basket and copy what is written on it onto a sheet of square-ruled paper.
2. He finds the answer to the addition on chart 3, recording it after the equal sign on his paper. The answer on chart 3 is located at the intersection of the column numbered by the first addend with the row numbered by the second addend.
3. The child continues in this manner until he tires of the exercise.
4. Then he checks the results written on his paper by comparing them with those on chart 1, and makes any necessary correction.

CHARTS - ADDITION - CONTINUED

LATER EXERCISES

1. Have the child use the second basket in conjunction with charts 4 and 2.
2. Have the child use the second basket in conjunction with charts 5 and 2.
3. Use either basket in conjunction with the blind chart and chart 3 as follows:
 - a) child picks a slip of paper from either basket;
 - b) mentally completes the addition;
 - c) places the tablet that describes this sum into the appropriate square on the blind chart;
 - d) after doing many examples the child checks for correctness of results with chart 3.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Charts 1, 2 and 3 and the teacher.

Addition

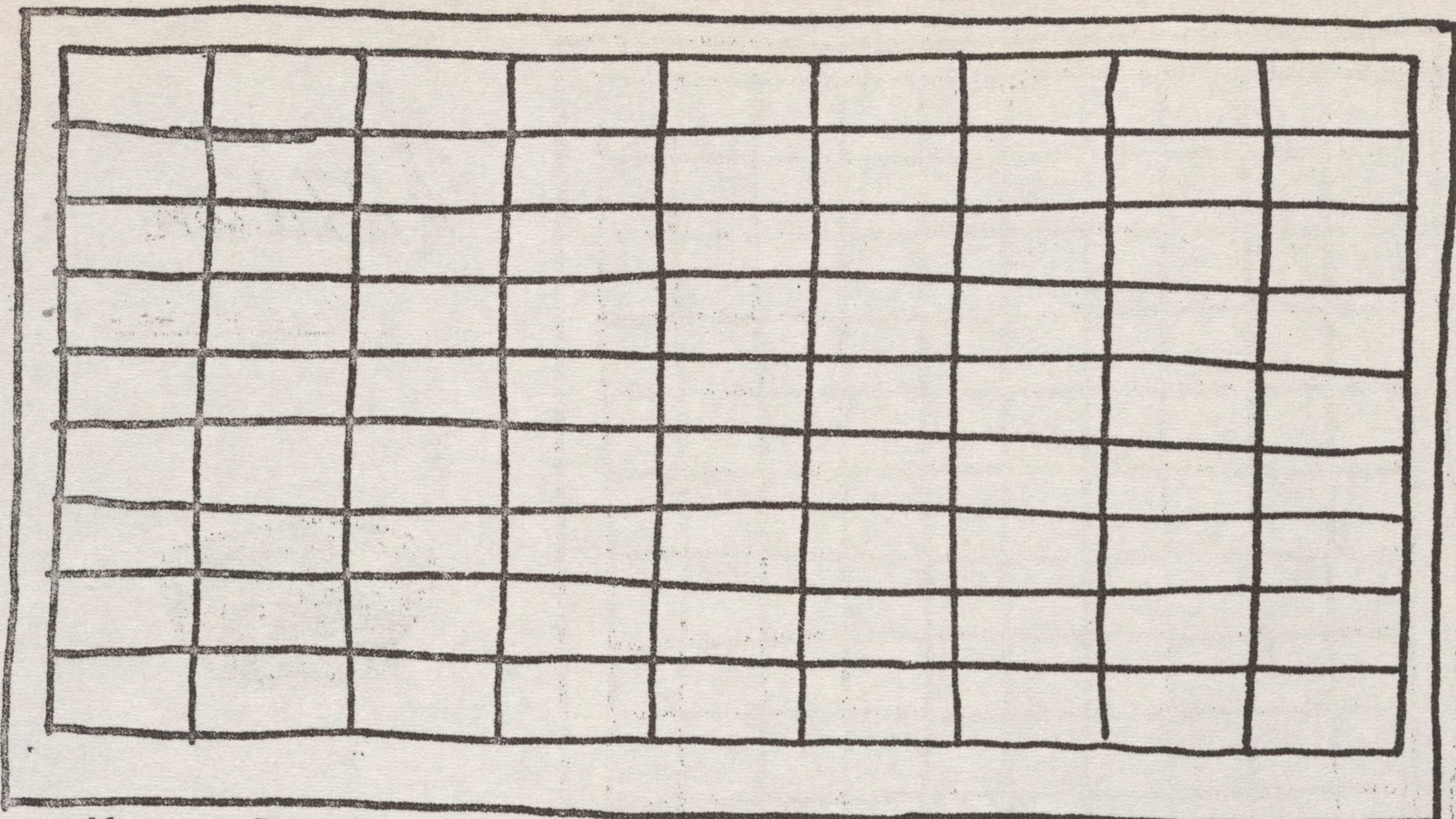


Chart I



$$2 + 2 =$$

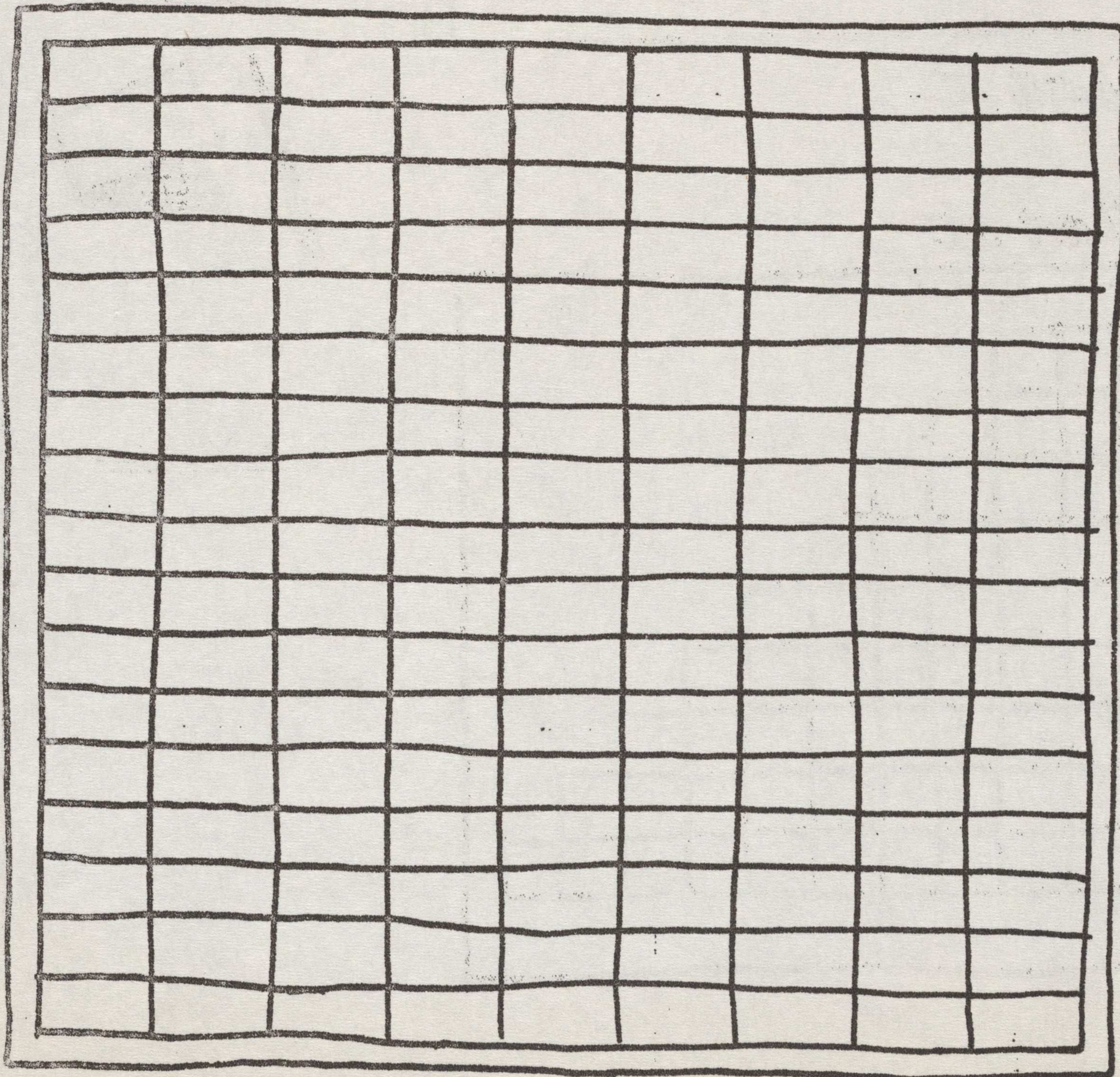
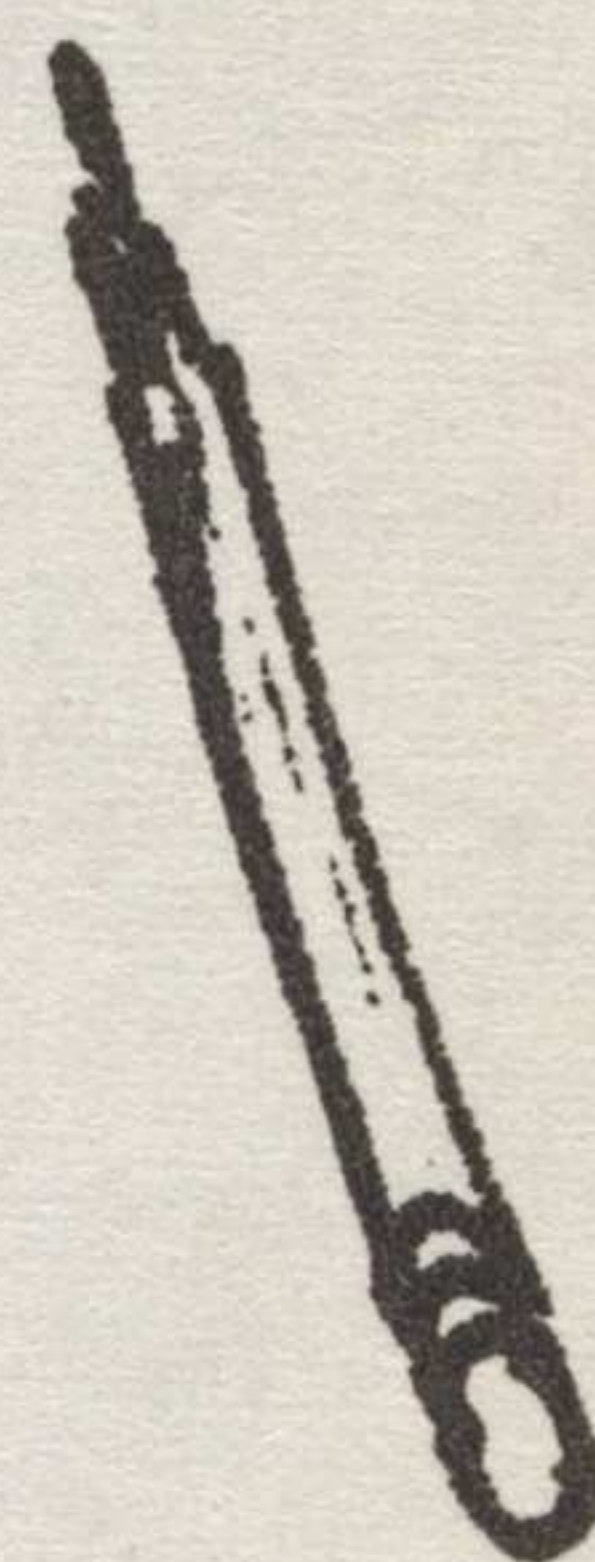
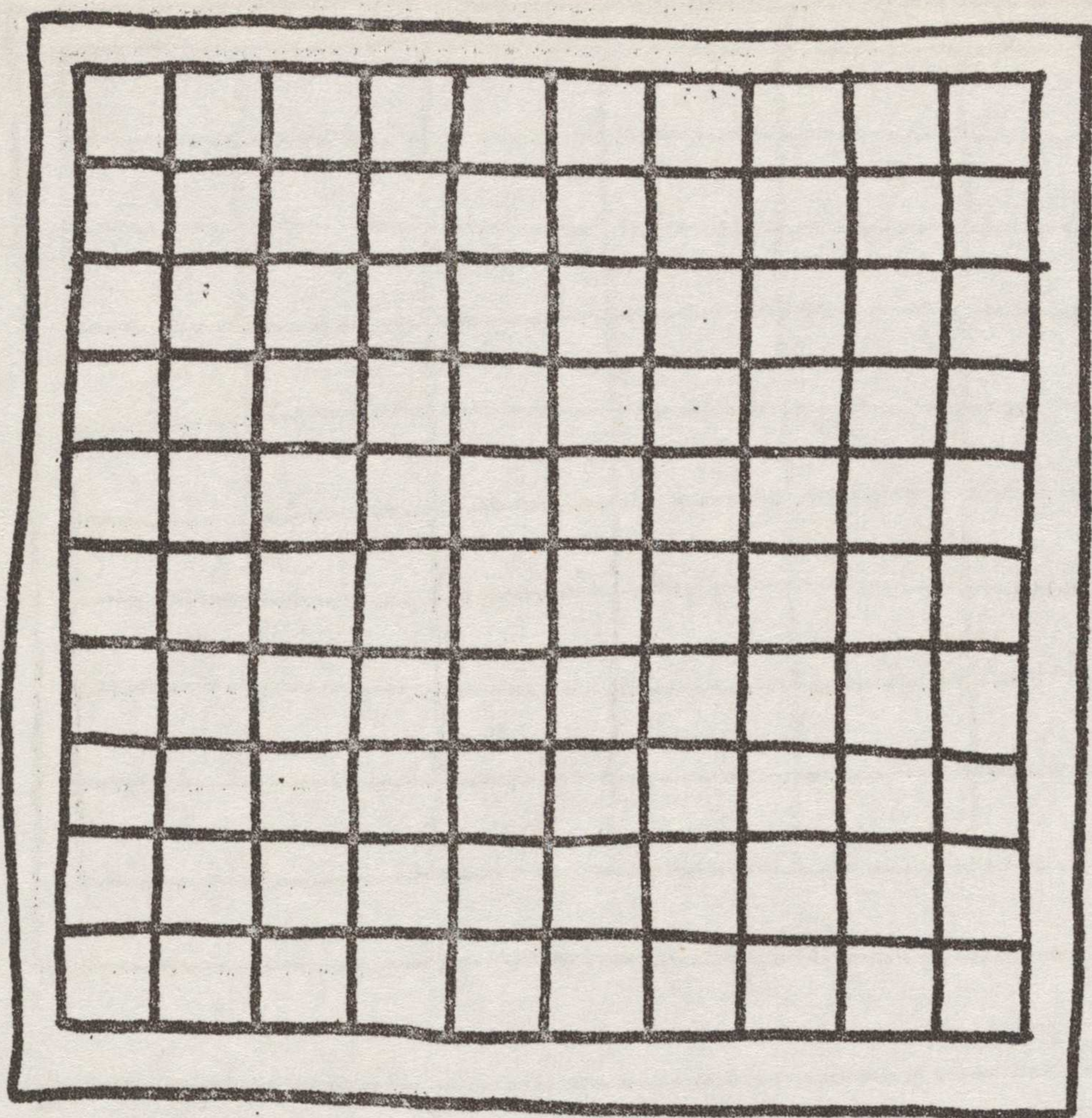


Chart II



Addition

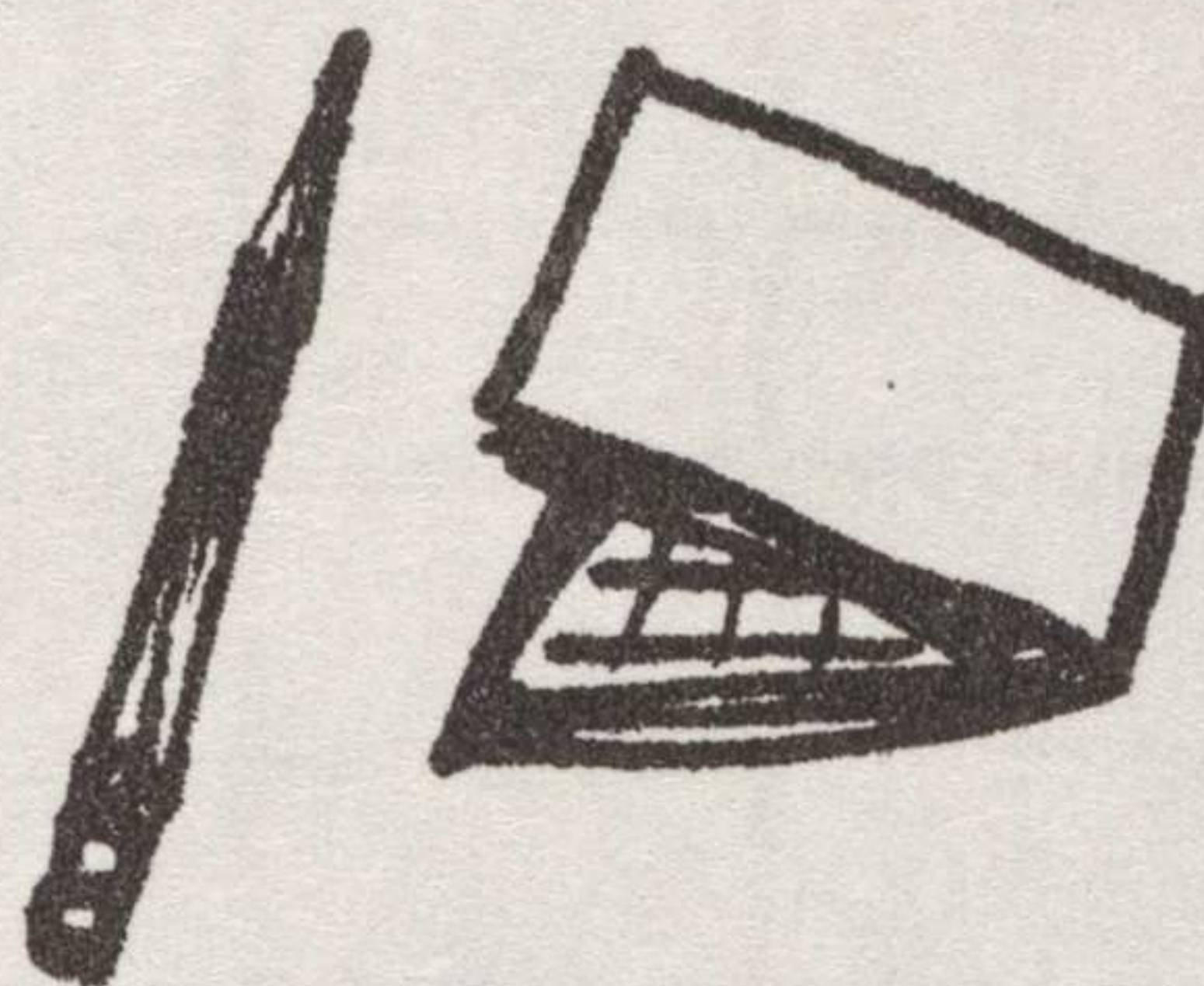


Chart III

Chart IV

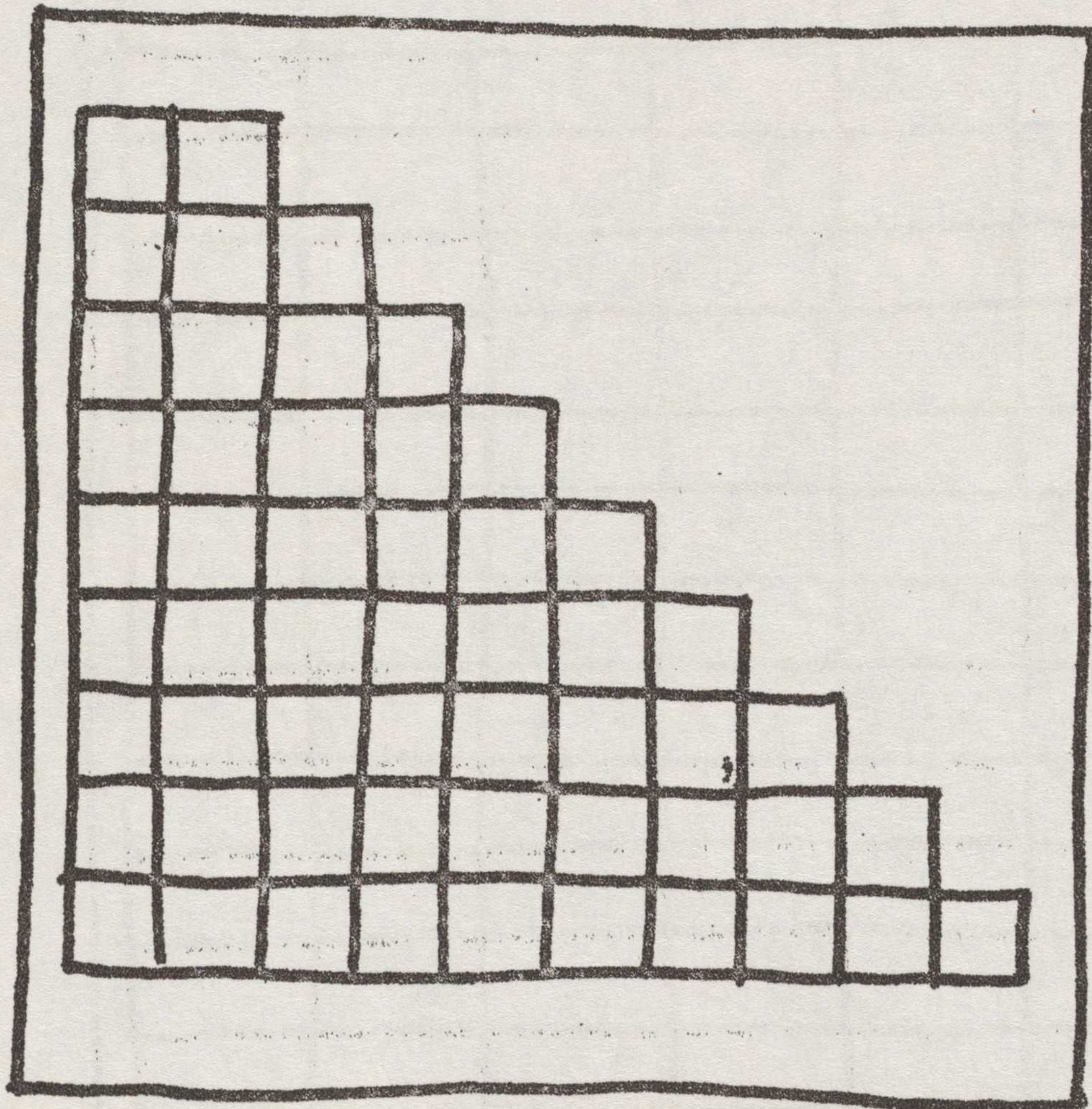


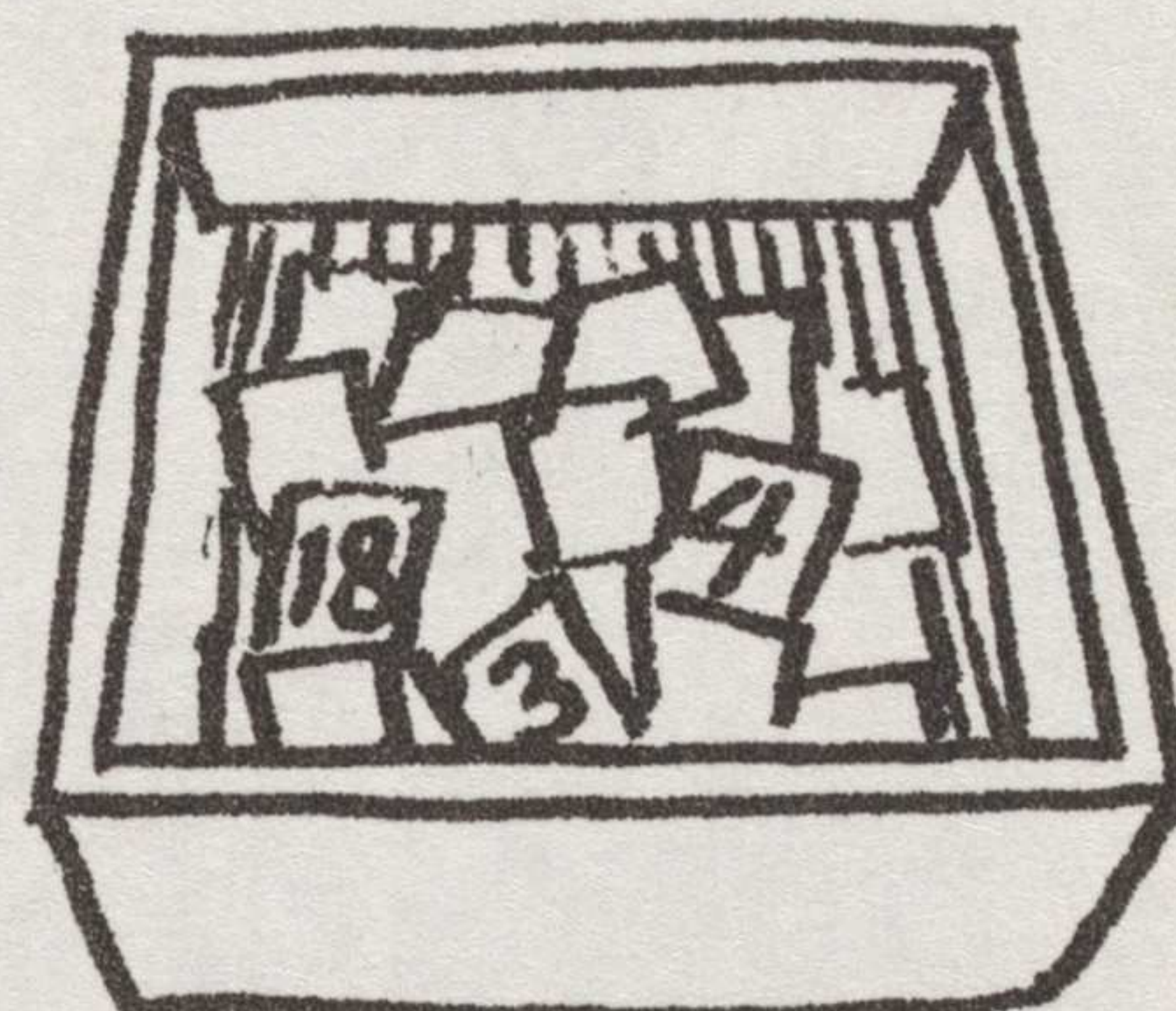
Chart V

1	2								
2	3	4							
3		5	6						
4			7	8					
5				9	10				
6					11	12			
7						13	14		
8							15	16	
9								17	18

0	1	2	3	4	5	6	7	8	9
1									
2									
3									
4									
5									
6									
7									
8									
9									

Blind Chart

Addition



[illegible]

NEGATIVE SNAKE

MATERIAL

A number of colored short bead stairs in a wooden box.

One black and white bead stair.

A number of negative bead stairs that are composed of translucent blue beads representing the number 1 to 9. In every bar that contains more than five beads, a double link separates the fifth bead from the others.

A number of gold bead bars of 10 beads each.

A small notched card and two small trays.

DIRECT AIM

To further familiarize the child with the operation of subtraction in preparation for the subtraction tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Form long snake of colored bead bars, inserting a number of negative bars towards the end of the snake. No two negative bars should lie adjacent in the snake. The number of beads contained in the colored bars that precede a negative bar should be greater than the number of beads in the latter.
2. Count off ten beads using the notched card. Insert the card between the 10th and 11th beads.
3. Place a gold bead bar alongside the counted beads in the bead snake.
4. If necessary, count the remainder of beads in the partly-counted colored bear bar and place alongside this remainder a bar from the black and white bead stair that has the same number of beads as the remainder.
5. Remove the colored bead bars that have been counted, beginning with the last counted bar, and place them apart from the material at hand.
6. Count ten more beads beginning with the black and white bead bar, if there was a remainder or with the colored bead bar, if there was no remainder. Proceed as above.
7. Continue counting in the above described manner until a negative bead bar is reached. At this point note the number of beads in the negative bar and reverse the direction of the counting. Count back the same number of beads as are in the negative bar and insert the notched card after the last counted bead. Complete counting the number of beads in the partly counted bar. Then place a black and white bead bar of the same number of beads alongside this remainder.

NEGATIVE SNAKE GAME - CONTINUED

8. Remove from the snake the negative bar and the bar or bars that were counted in reverse. Put the negative bar on a tray, the colored bars on another tray and the gold bar - if any - back with the supply of gold bars.
9. Join the two parts of the snake and continue counting until all beads in the snake have been counted.
10. Arrange the colored bars that formed the snake into groups of like bars. Place the groups and the bars within each group, horizontally.
11. Arrange the gold bars and the black and white bar that were used in the snake game below the groups of colored bars leaving a space between each bar as it lies vertically to the groups.
12. Match every negative bar with a colored bar of the same number of beads.
13. Then match the gold bars with the remaining colored bars, making all exchanges necessary for a one-to-one matching. Place the colored bars alongside the gold bars.

NOTE: A one-to-one matching will only be possible if no mistakes were made in the counting.

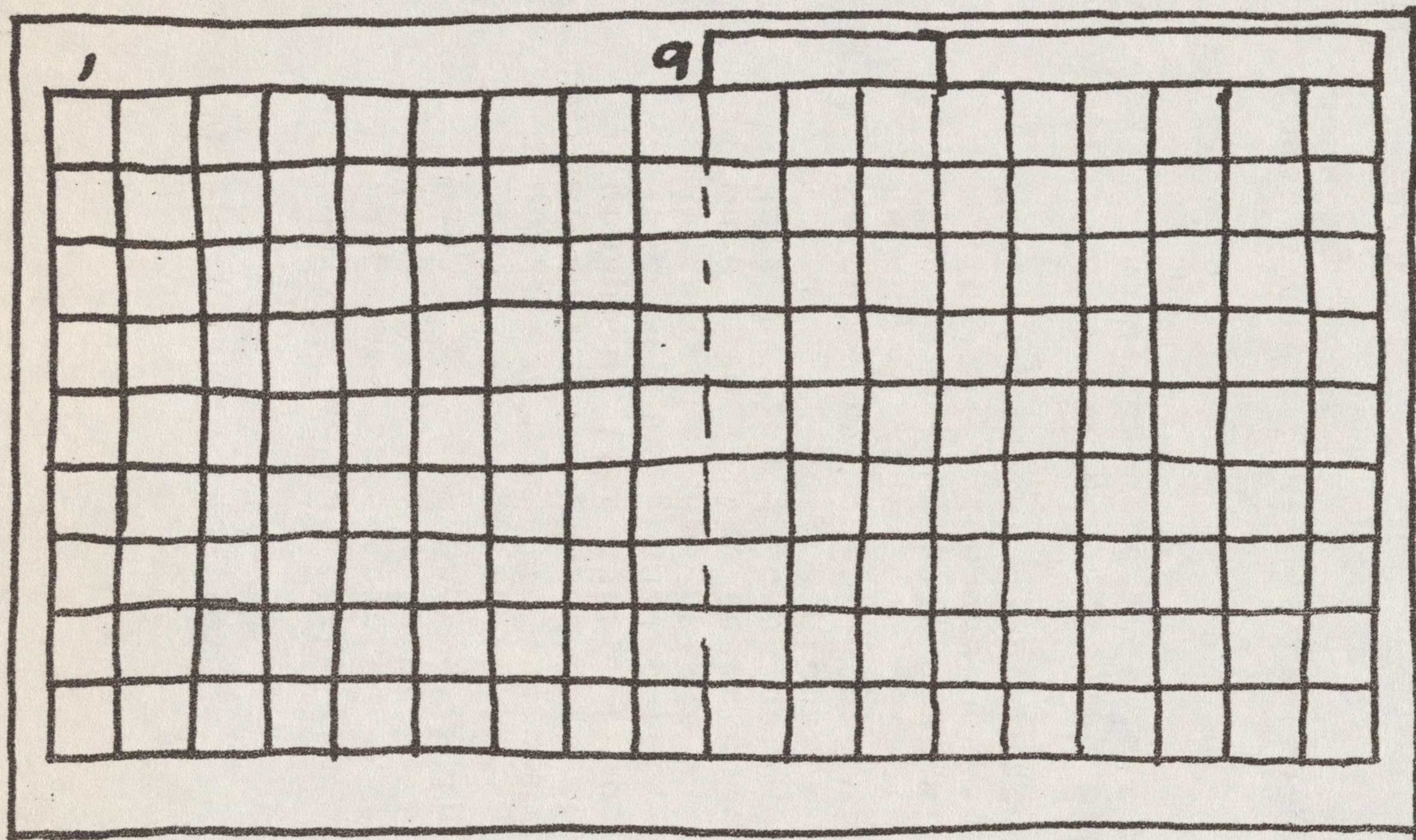
LATER EXERCISES

Count a snake that has the same number of positive and negative beads

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The final matching and the teacher.

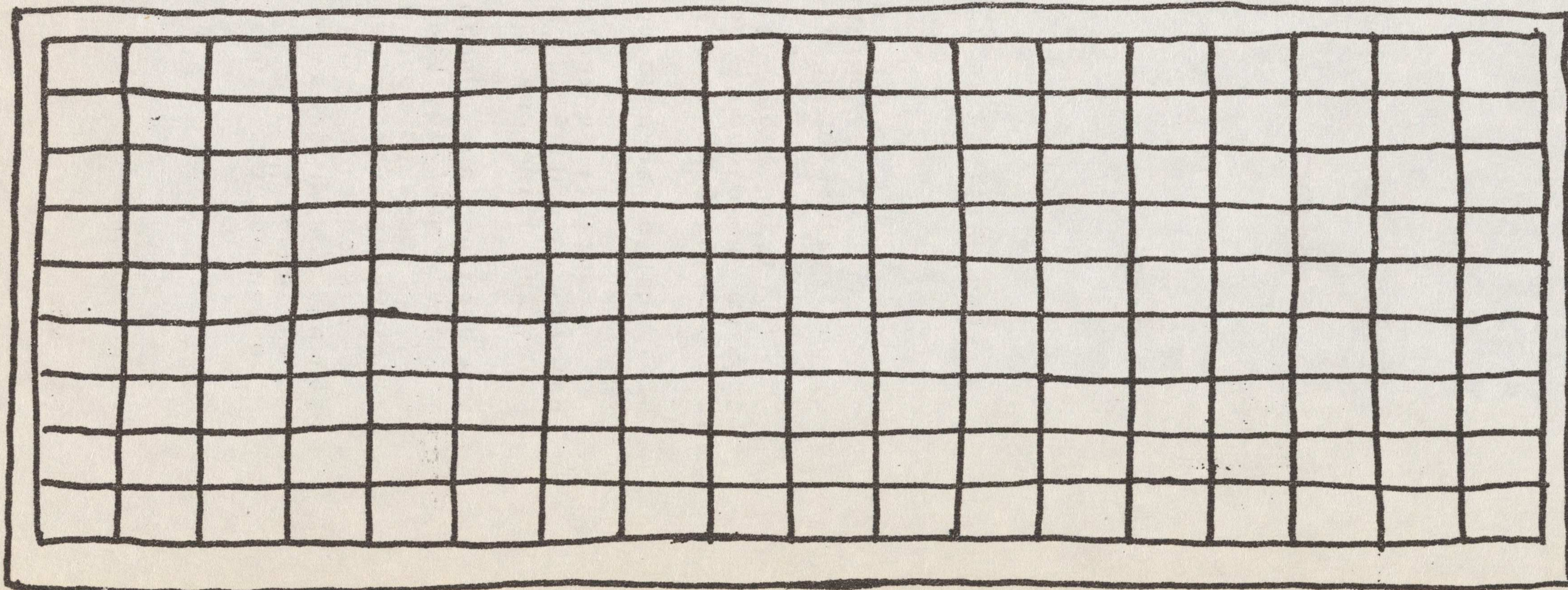


12	-1 =	11
12	-2 =	10
12	-3 =	
	-4 =	
	-5 =	
	-6 =	
	-7 =	
	-8 =	
	-9 =	



Negative Strip Board

Chart I



STRIP BOARD - SUBTRACTION**MATERIAL**

Rectangular wooden board, with the numerals 1 to 9 printed in black and the numerals 10 to 18 printed in red across the top as columnar headings. The board is divided into 2 cm squares - 9 down and 18 across. Columns 9 and 10 are separated by a heavy line.

A set of blue wooden strips, 2cm wide and from 2cm to 18cm long. Each strip has one of the numerals 1 to 9 printed at the right end. The shortest strip has the numeral 1 and the longest the numeral 9 printed on it.

A set of red wooden strips, 2cm wide and from 2cm to 18cm long. Each strip is divided into 2cm squares and has one of the numerals 1 to 9 printed in the right end square. The shortest strip has the numeral 1 and the longest has the numeral 19.

A set of 18 blank unpainted wooden strips, 2cm wide and from 2cm to 36cm long.

A number of slips of paper each of which looks as follows:

-9=
-8=
-7=
-6=
-5=
-4=
-3=
-2=
-1=

Chart 1 is a subtraction table (see N. Newkirk illustration when completed).

DIRECT AIM

To construct the subtraction table.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Explain to the child that for the purpose of this exercise we are interested in results of 9 or less than 9.
2. Arrange the strips of each set in numeral sequence.
3. Choose the sum of 18. Place the blue strip marked with the numeral 9 so that it masks the numerals 10 through 18. Read the result at the left end of the blue strip.
4. Record the sum of 18 and the second addend nine on the slip of paper provided for this purpose. Remove the blue strip marked with the numeral 9.

STRIP BOARD - SUBTRACTION - CONTINUED

5. Show that when the blue strip marked with the numeral eight is used, the result would be greater than nine. Hence, it should not be used at this point.
6. Mask the numeral 18 with the smallest blank tablet.
7. Place the blue strip marked with the numeral 9 so that it masks the numerals 9 through 17. Read the result at the left end of the blue strip.
8. Record the sum 17 and the second addend 8 on another slip of paper provided for this purpose. Remove the blue strip marked with the numeral 9.
9. Place the blue strip marked with the numeral 8 so that it masks the numerals 10 through 17. Read the result at the left end of the blue strip.
10. Record the sum 17 and the second addend 9 on the slip of paper just used.
11. Continue to ask the numeral headings that do not apply at the time, and use the blue strips as described above.
12. Check the recorded results (second addends) against chart 1.

LATER EXERCISES

Select any sum between 1 and 18, inclusively, and mask the numerals to the right of this sum. Assume, for example, that the sum is 6.

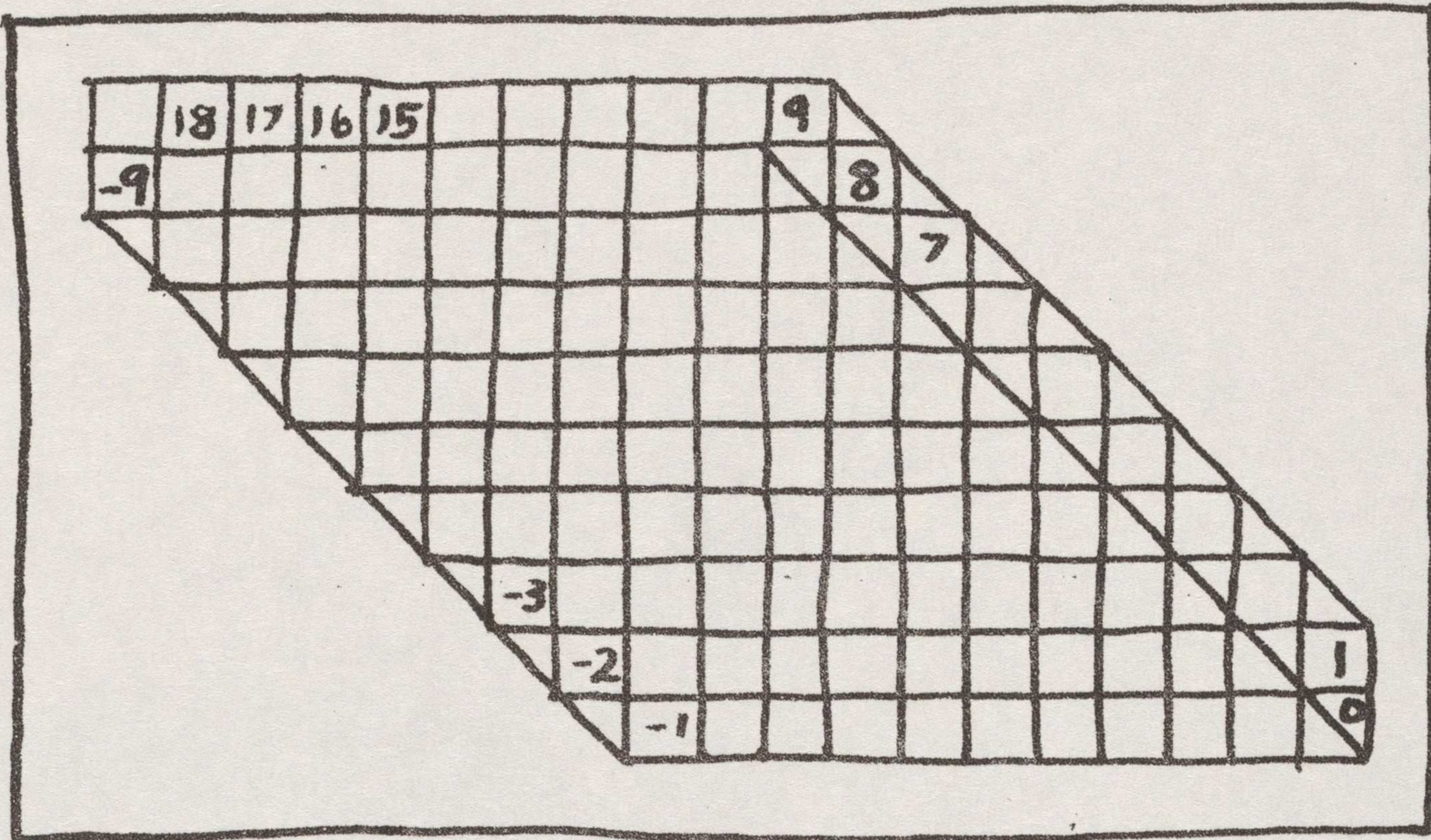
- a) Place a red strip marked with the numeral 5 on the board so that it masks the first five squares of the first row. Ask the child what number must be added to 5 in order to make 6. Then place the blue strip marked with the numeral 1 on the sixth square of the first row.
- b) Place the red strip marked with the numeral 4 on the board so that it masks the first four squares of the second row. Ask the child what number must be added to 4 in order to make 6. Then place the blue strip marked with the numeral 2 on the fifth and sixth squares of the second row. Continue this process to the fifth row.
- c) Remove the blue strip marked with the numeral 1 from the board enunciating, "the difference between 6 and 5 is 1". Record the equation.
- d) Remove the blue strip marked with the numeral 2 from the board, enunciating, "the difference between 6 and 4 is 2". Record the equation. Continue in this manner until all blue strips have been removed from the board. Check the recordings against chart 1.

AGE 5 to 6-1/2 years.

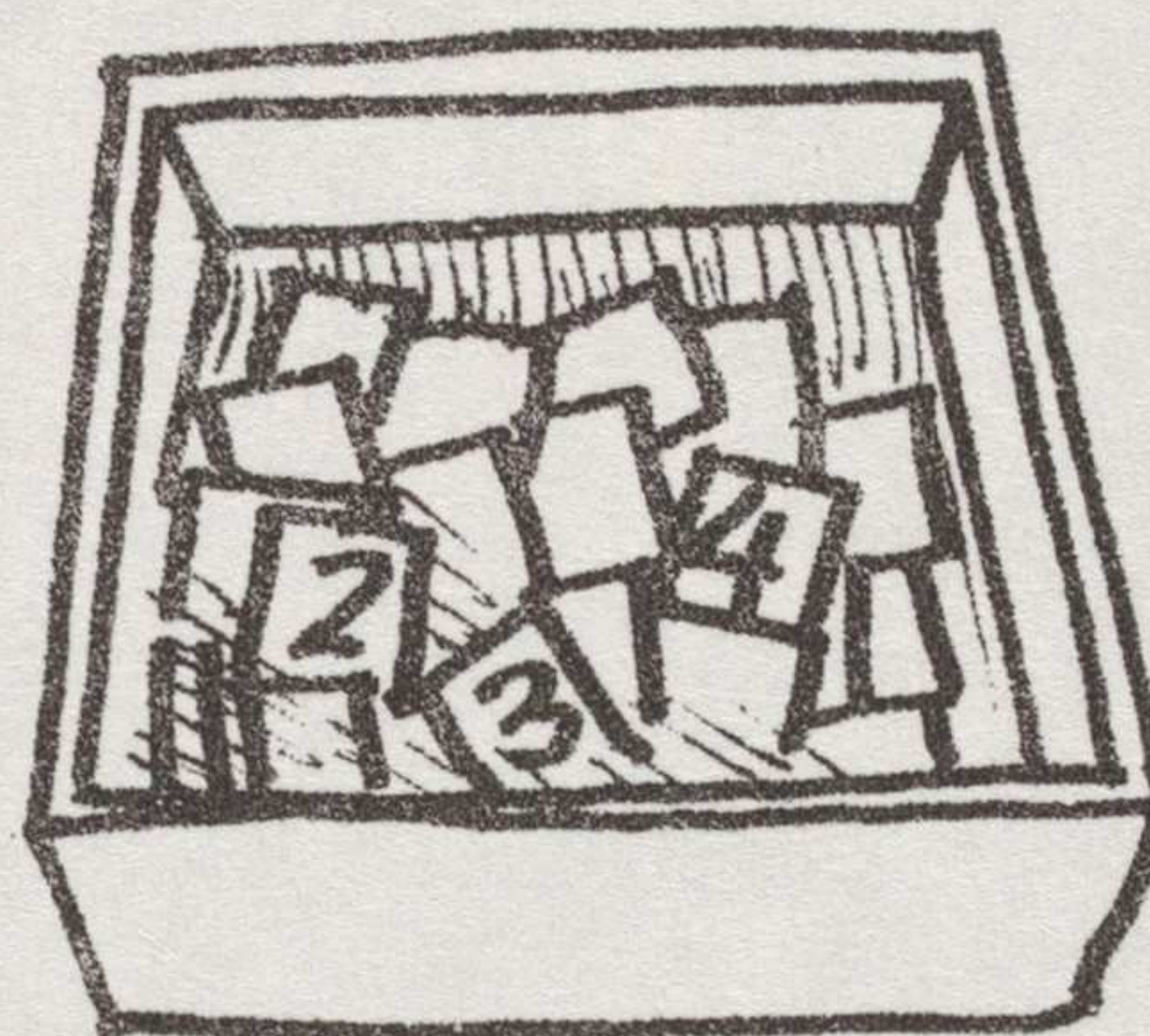
CONTROL OF ERROR

The teacher and Chart 1.

Subtraction



Blind Chart



CHARTS - SUBTRACTION

MATERIAL

Two subtraction tables and one blind chart as illustrated by Newkirk and in attachment. Throughout this exercise these will be referred to as chart 1 or 2; the blind chart will be referred to by this name.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of chart 2. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written the same combinations of sum and first addend as appear on the partially completed chart 1 illustrated by Newkirk. Sum and first addend are separated by a minus sign and equal sign follows the addend. The second addend is not given. There is one slip of paper for every pair of numbers.

Pencils and square-ruled paper.

DIRECT AIM

To use various forms of subtraction tables in order to have the child memorize the results of the subtraction operations that are contained in these tables.

INDIRECT AIM

To develop mathematical understanding.

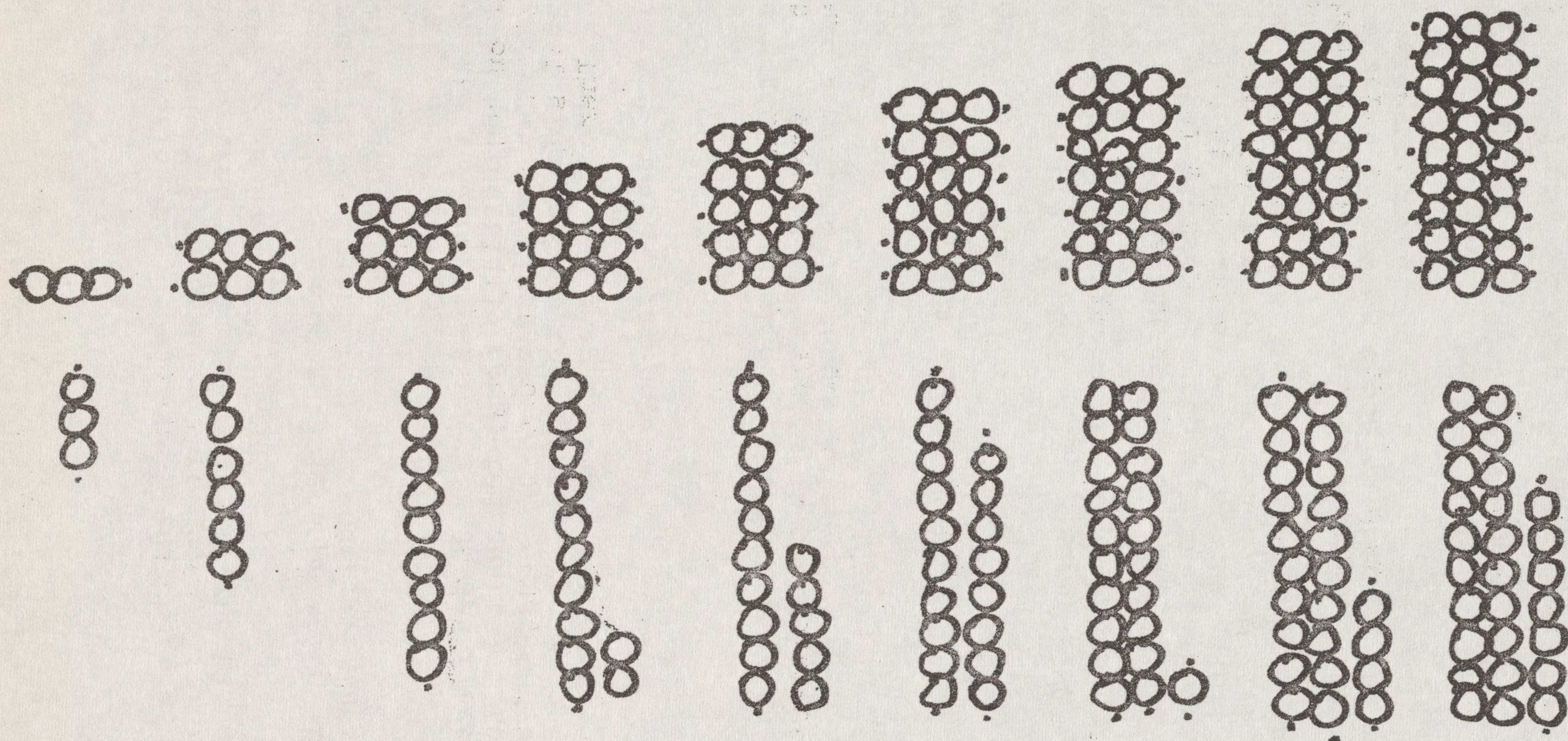
PRESENTATION

1. Have the child pick a slip of paper from the basket and copy what is written on it onto a sheet of square-ruled paper.
2. He finds the second addend on chart 2, recording it after the equal sign on his paper. The unknown addend is located at the intersection of the column numbered by the sum with the row numbered by the first addend.
3. The child continues in this manner until he tires of the exercise.
4. Then he checks the results written on his paper by comparing them with those on chart 1 and makes any necessary corrections.

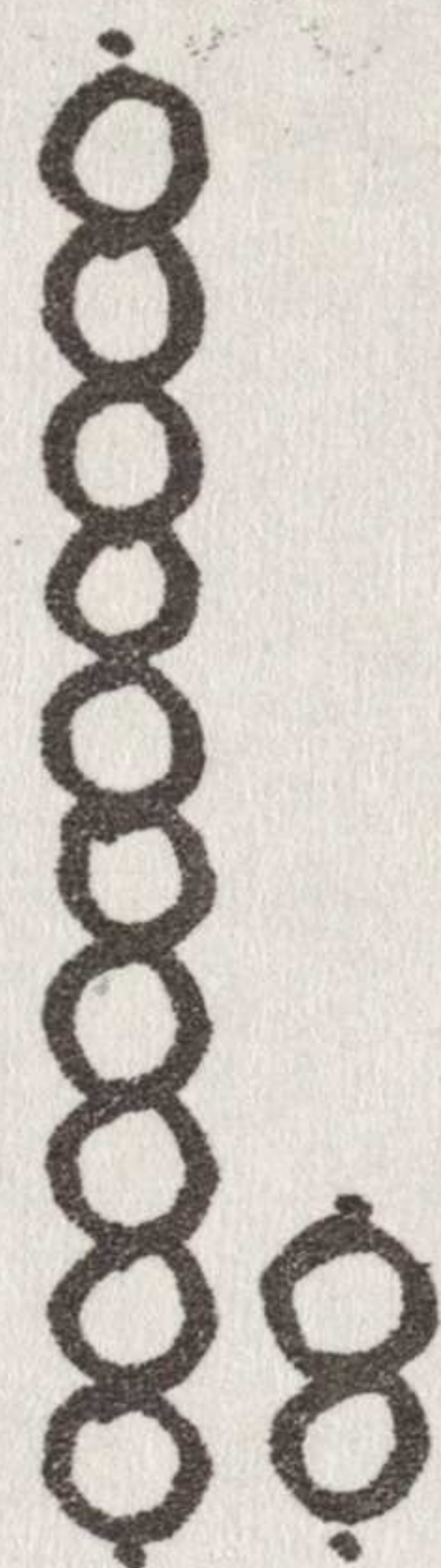
LATER EXERCISES

Use the basket in conjunction with the blind chart and chart 2 as follows:

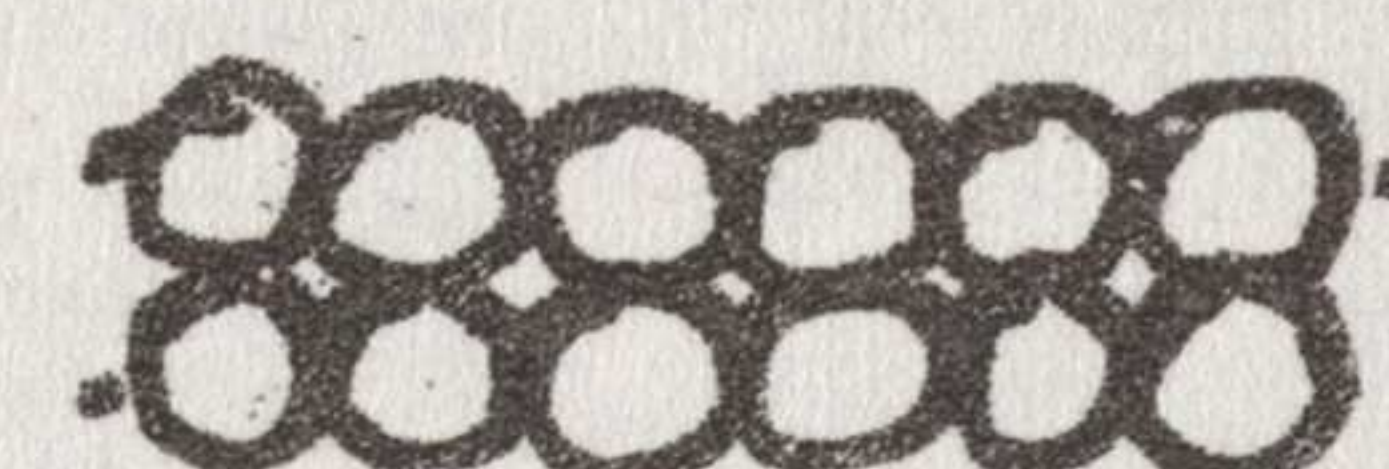
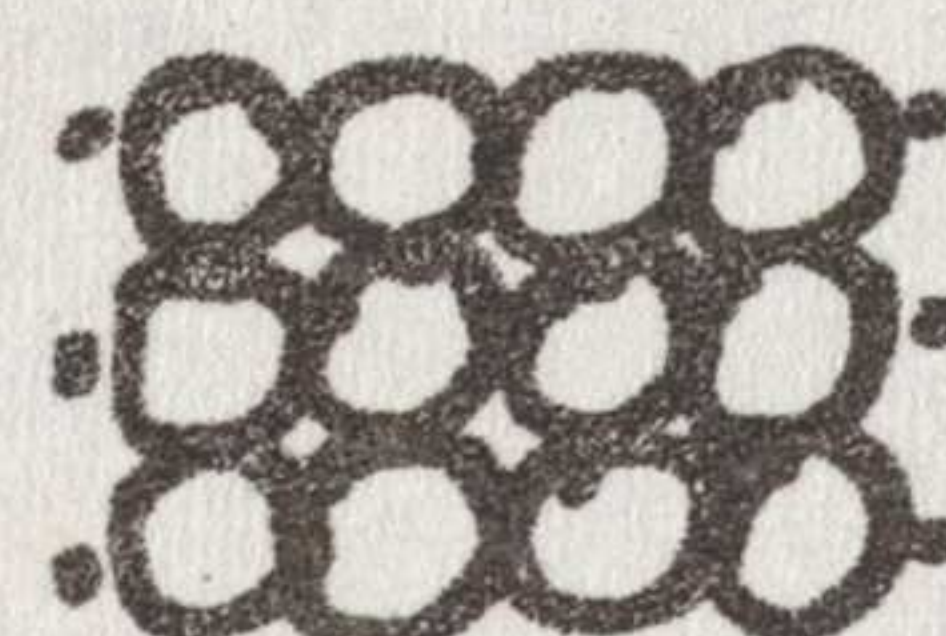
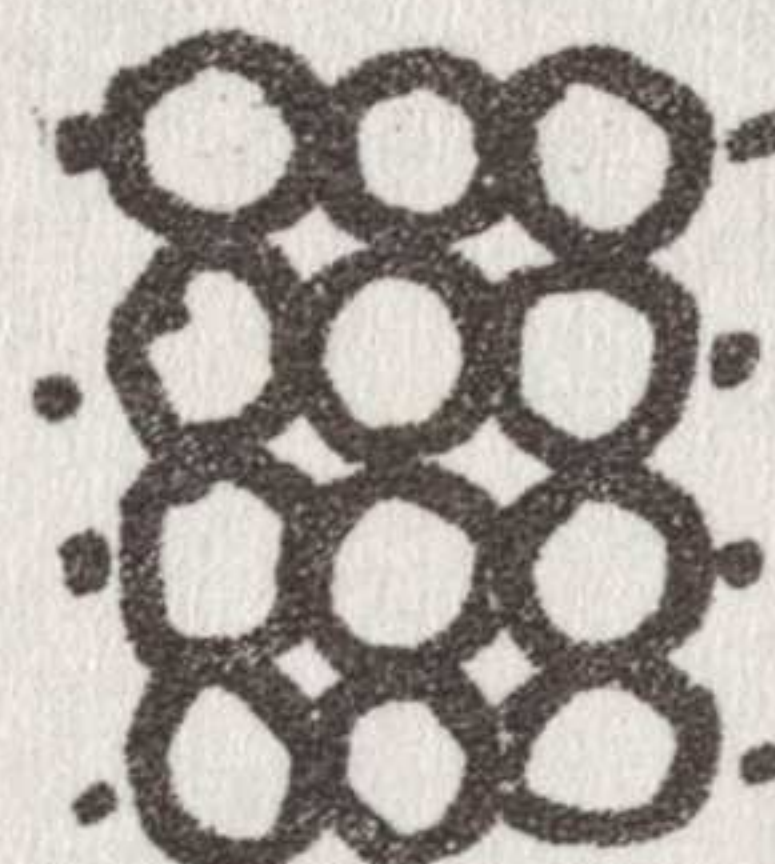
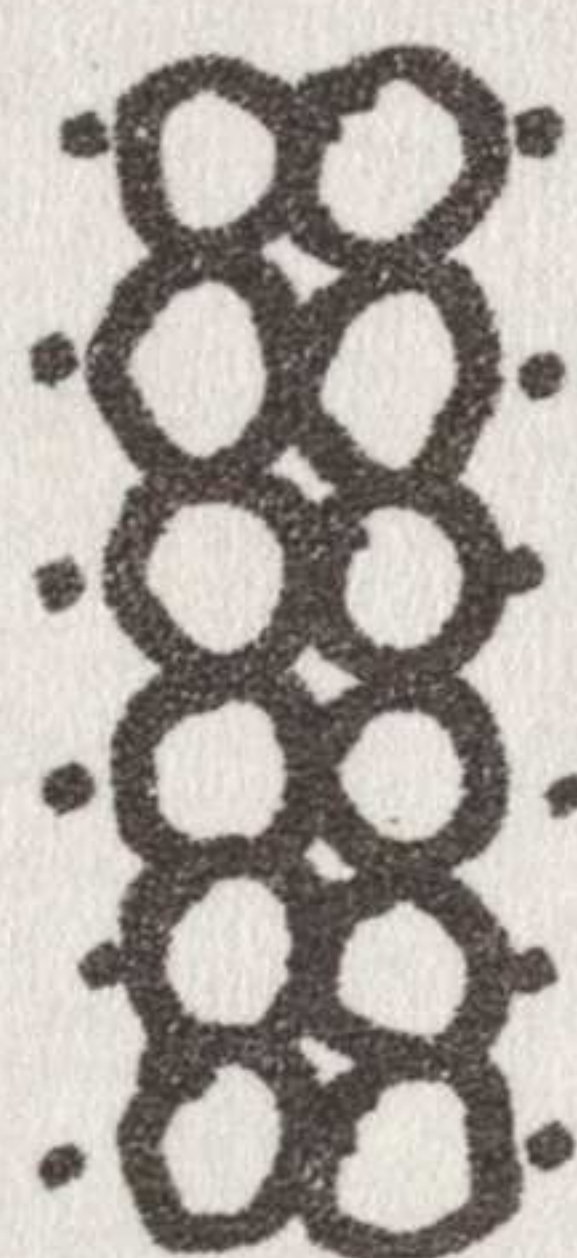
- a) child picks a slip of paper from the basket;
- b) mentally solves for the unknown addend;
- c) places the tablet that describes this addend into the appropriate square on the blind chart;
- d) after doing many examples the child checks for correctness of results with chart 2.

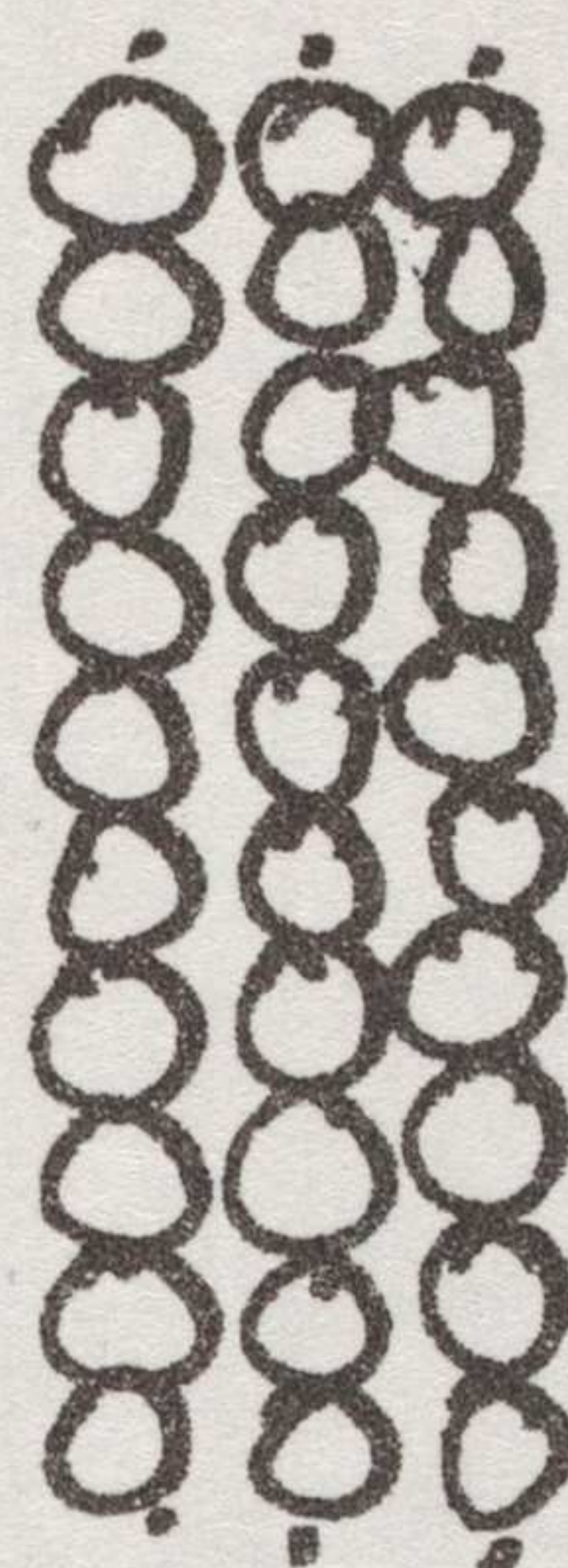
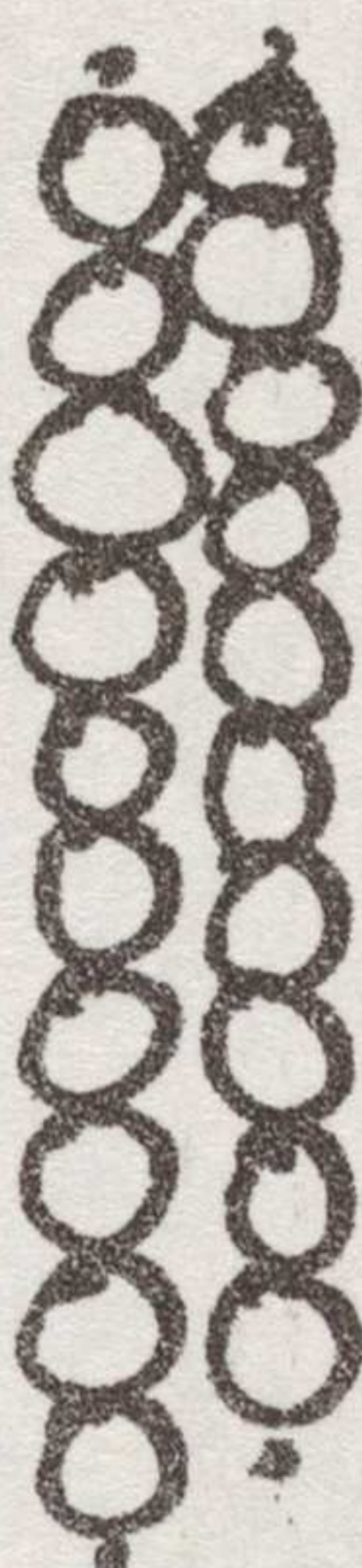
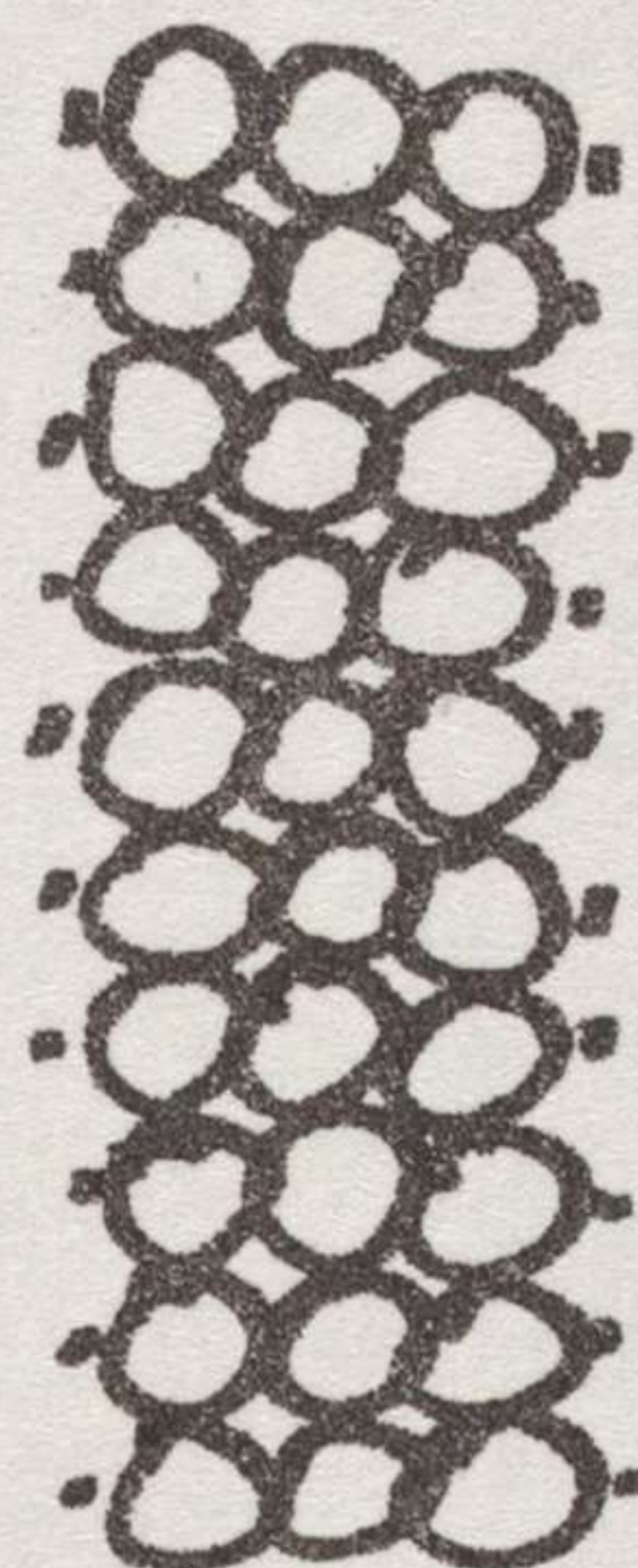
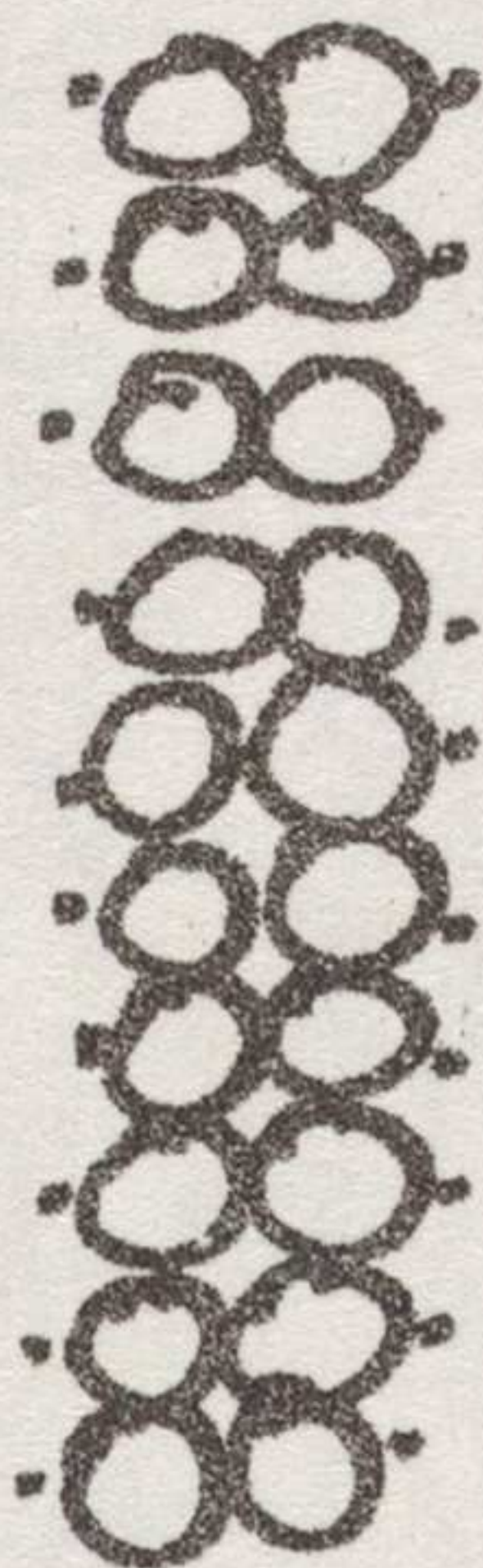


Construction of a Multiplication Table



Many Ways of Making a Number





Take Ten Times a Number

MULTIPLICATION WITH BEAD BARS

MATERIAL

55 colored bead stairs. 55 gold bead bars of 10 beads each.
10 black and white bead stairs. 10 different colored bead squares. Slips of paper and pencils.

DIRECT AIM

To construct multiplication tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Let the child choose the table to be constructed. Assume, for the purposes of demonstration, that he chooses 6.
2. Take one bar of 6 beads and place it horizontally.
3. Below and vertical to it place a black and white bar of six beads.
4. Now take two bars of 6 beads each and place them horizontally one below the other and to the right of the first bar. Below these two bars, represent the quantity 12 by using one gold bead bar and the black bar of 2 beads. Place these two bars vertically to the two 6-bars.
5. Continue in this manner until 10 bars of 6 beads each, have been placed and every quantity has been represented by the appropriate combination of gold and black and white bead bars.
6. Superimpose the bead square of 6 on the 6 rows of 6 bars. Enunciate that 6 taken 6 times forms the square of 6.

LATER EXERCISES

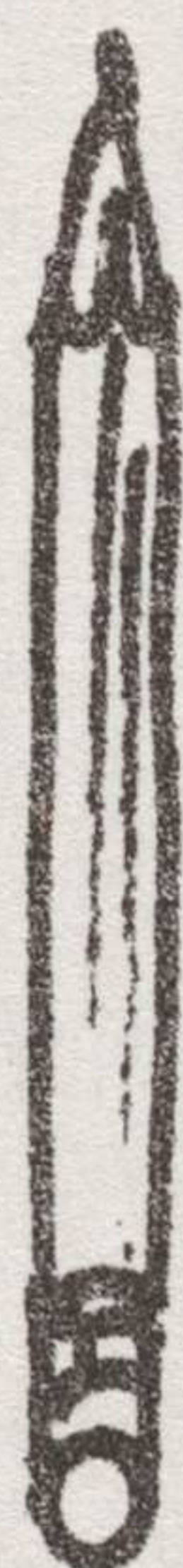
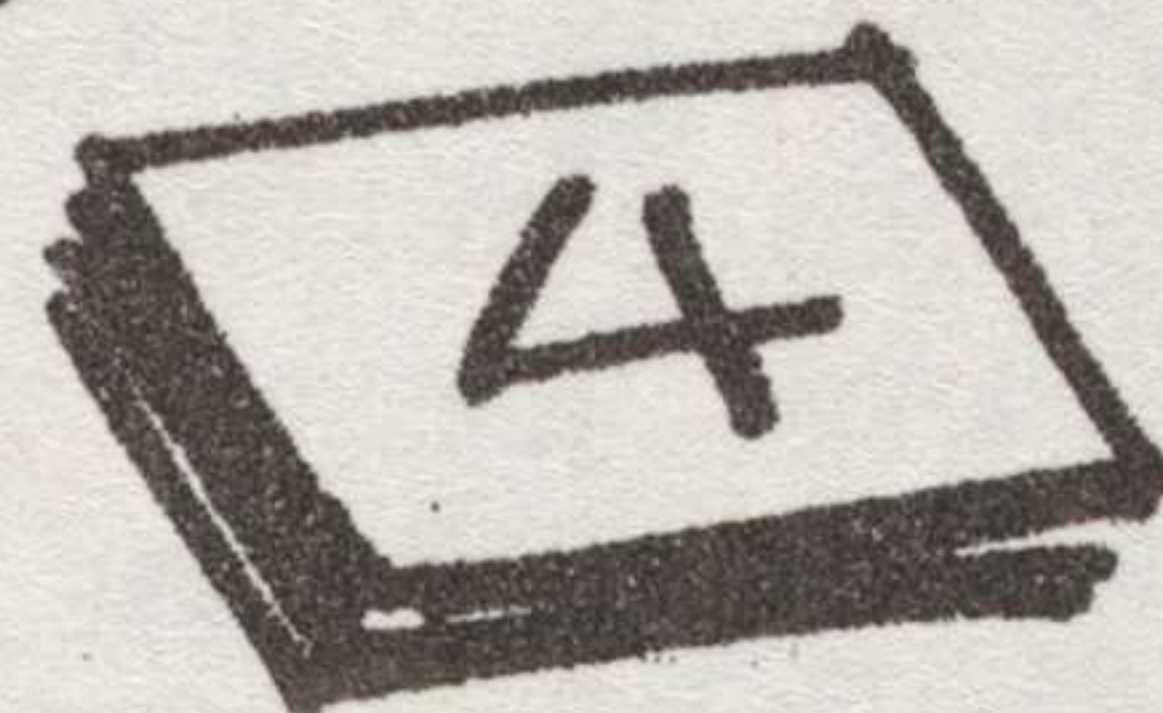
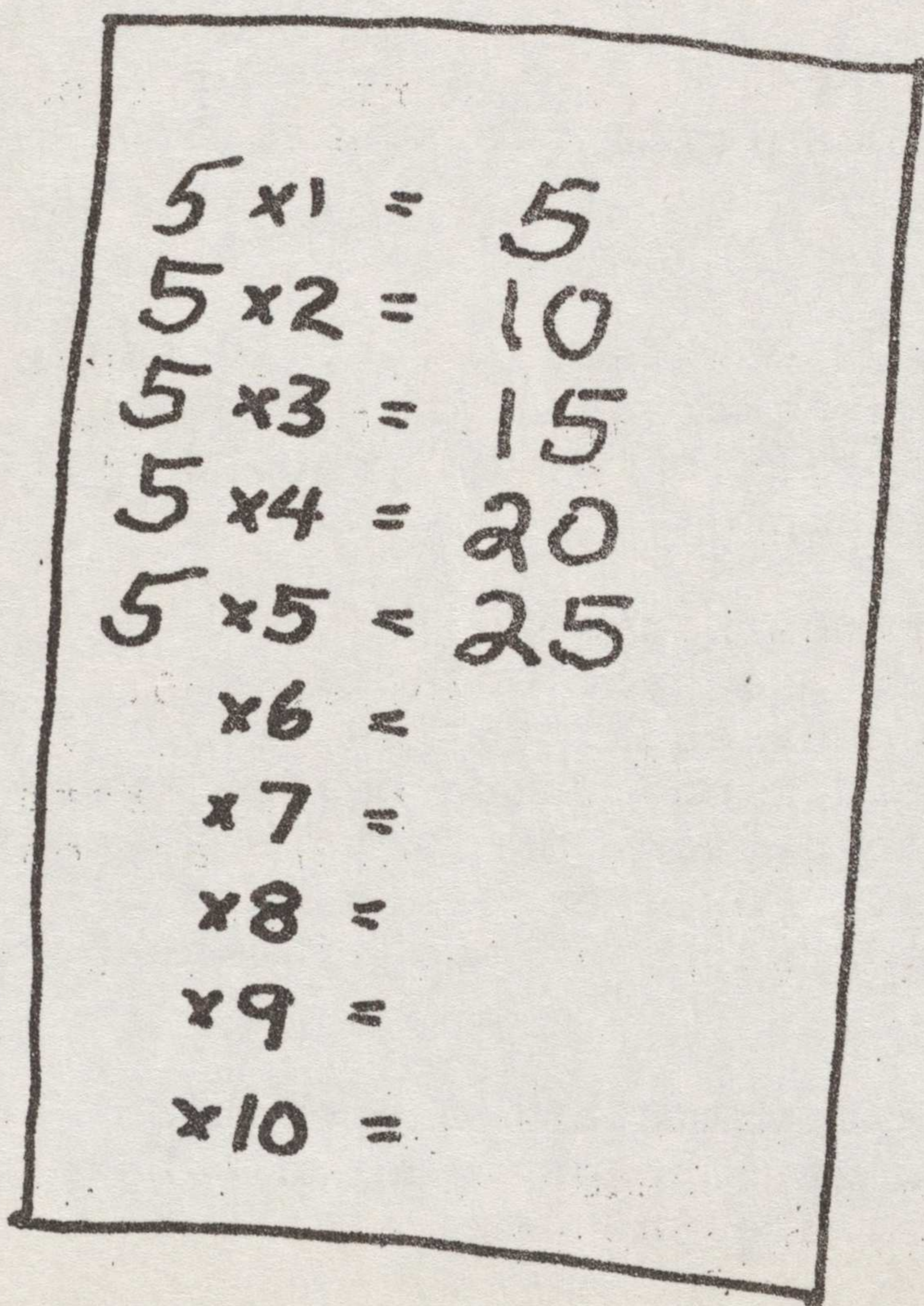
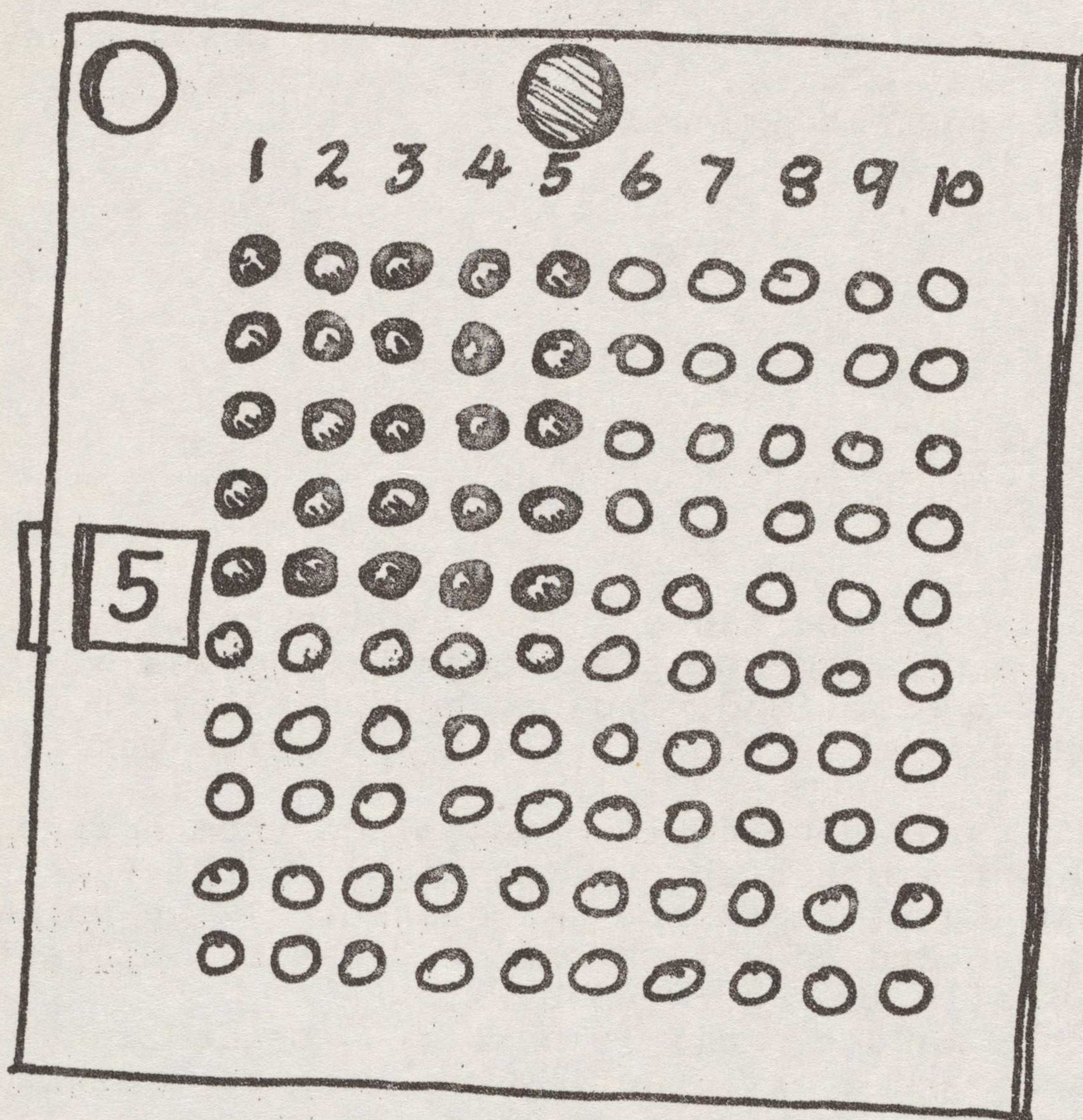
1. Construct arrays of 10 twos, 10 threes,, 10 tens. Form the respective totals below the arrays, in the manner described above. As each total is formed, record it as follows, taking 20 for an example:
 - a) Record the numeral 2;
 - b) Enunciate "2 taken 10 times makes 20";
 - c) Add the 0 to the numeral 2 as you enunciate 20.
2. Select any product less than or equal to 100, e.g. 12. Form this quantity in gold and black and white beads. Form this product in as many combinations of factors as possible using the colored bead bars. For example, 6 bars of 2 beads each, 4 bars of 3 beads each, 3 bars of 4 beads each, and 2 bars of 6 beads each.
3. Show that multiplication is a commutative operation. For example, superimpose 2 bars of 6 beads each on 6 bars of 2 beads each to show they are the same size.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

The teacher.

Multiplication Board



MULTIPLICATION BOARD**MATERIAL**

A wooden board with 100 holes arranged in the form of a square. The ten columns of holes are numbered 1 through 10. On the left side of the board is a slot for insertion of a numeral card. In the top left corner is a circular groove that holds a removable disk.

10 small cards on which are printed the numerals 1 through 10.

A jar that contains 100 light blue beads.

Multiplication chart 1 as illustrated in the attachment.

A number of slips of paper each of which looks as follows:

x 1=
x 2=
x 3=
x 4=
x 5=
x 6=
x 7=
x 8=
x 9=
x 10=

DIRECT AIM

To construct multiplication tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Let the child choose the table to be constructed. Assume, for purposes of demonstration, that he chooses 5.
2. Insert the card marked with the numeral 5 into the slot on the board and place the disk above the numeral 1.
3. Put 5 beads (or ones) into the first column of holes, starting from the top of the board.
4. Record the factor 5 and the product 5 on the prepared slip of paper. As you do so, enunciate "5 times 1 equals 5".
5. Move the disk above the numeral 2 on the board. Put 5 beads into the second column of holes, starting from the top of the board.
6. Record the factor 5 and the product 10 on the same slip of paper. As you do so, enunciate "5 times 2 equals 10".
7. Continue as before until there are five rows of 10 beads each. Record as before.
8. Check the recordings against the multiplication chart 1.

LATER EXERCISES

Construct all the tables 1 through 10 in the manner described above.

AGE 5 to 6-1/2 years

CONTROL OF ERROR Chart 1 and the teacher.



$$2 \times 4 =$$

Multiplication

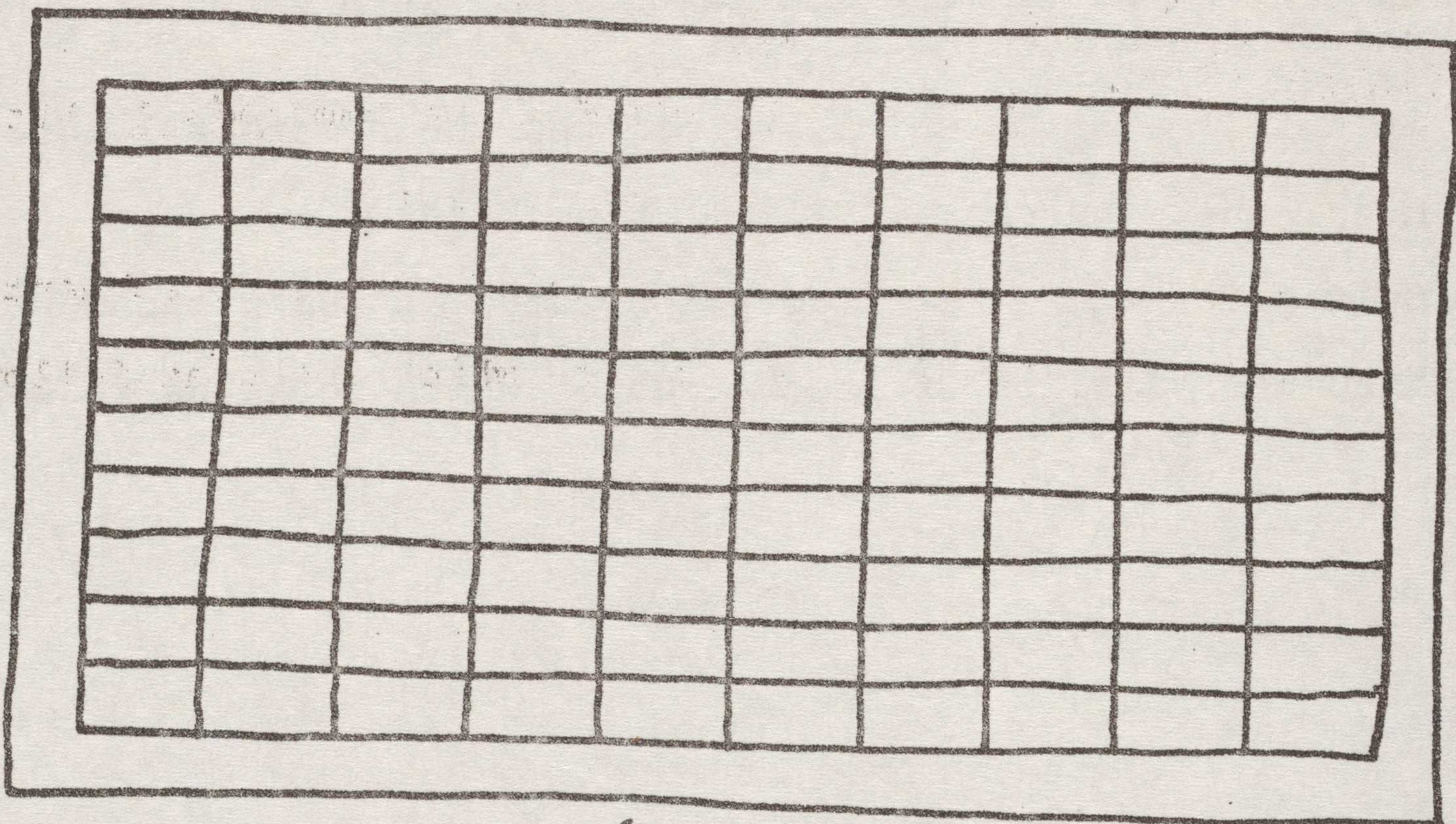
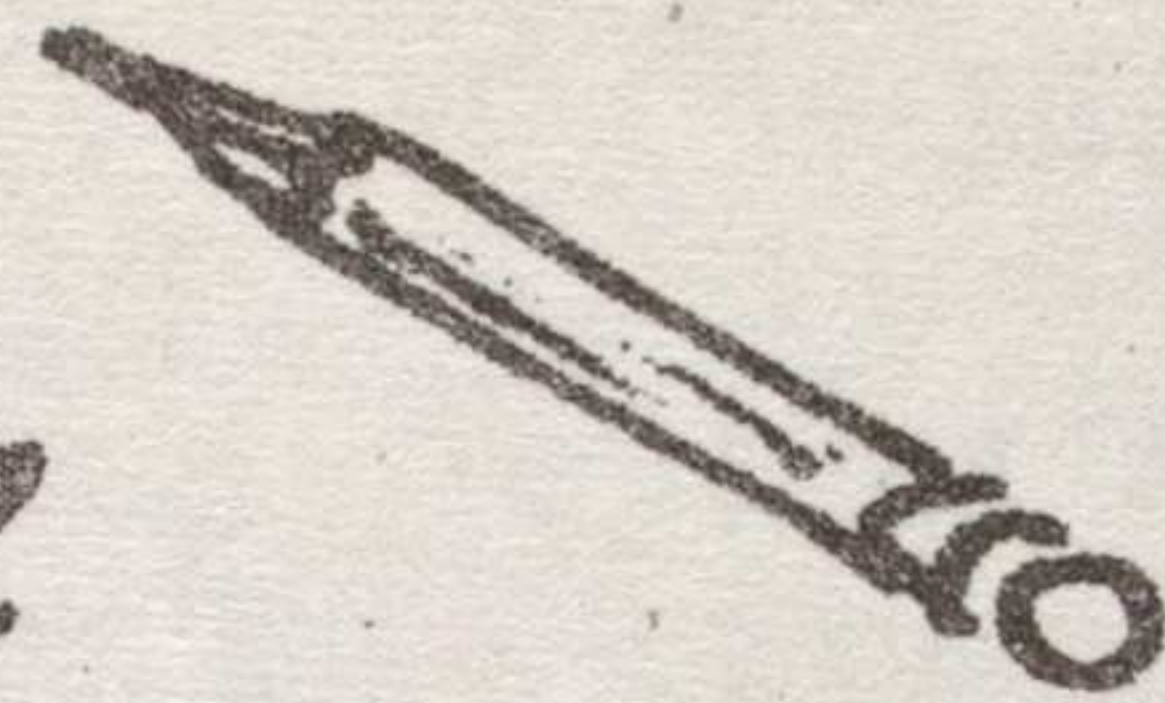


Chart I

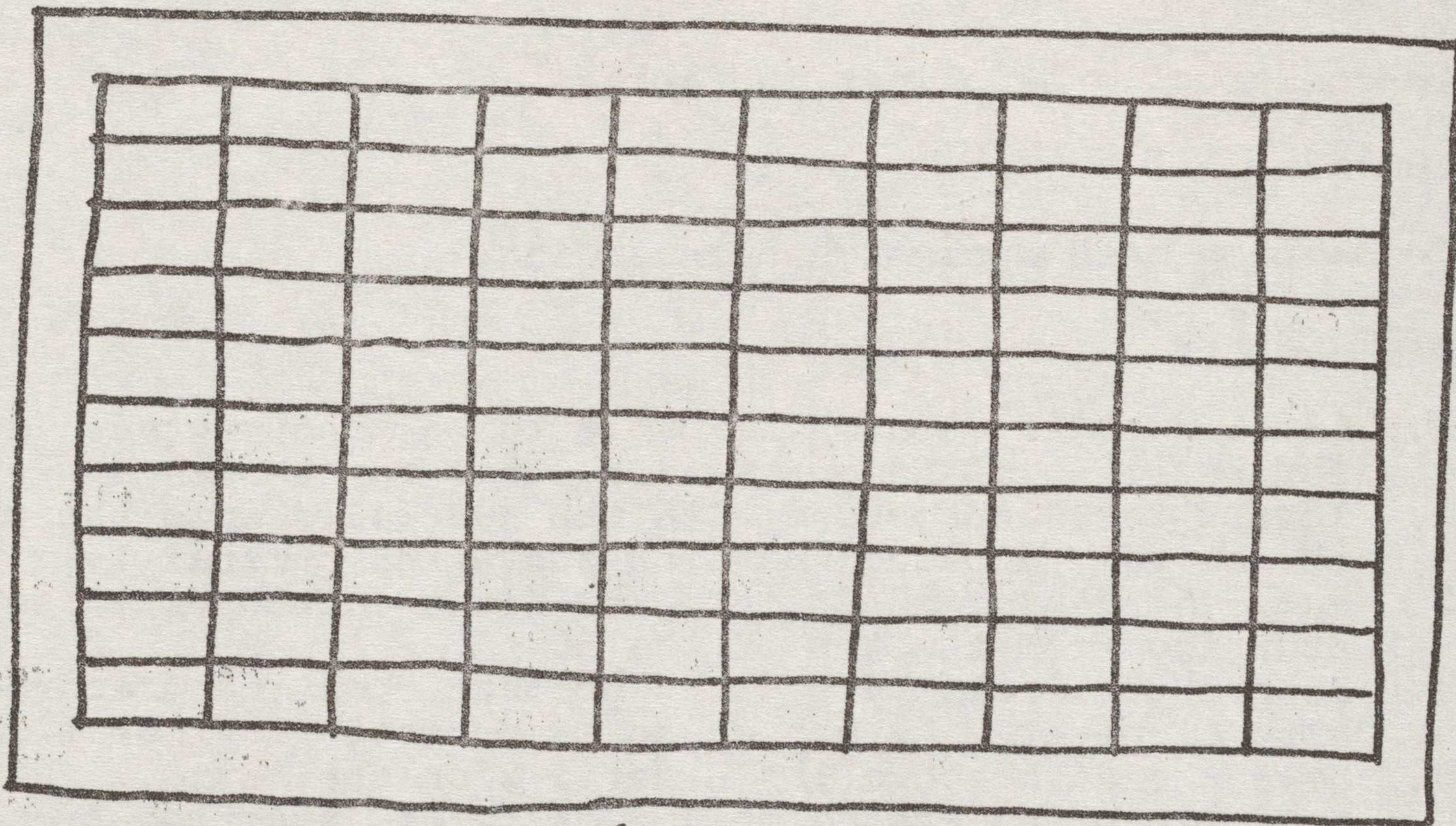


Chart II

CHARTS - MULTIPLICATION

MATERIAL

Three multiplication tables and one blind chart as illustrated in the attachment. Throughout this exercise these will be referred to as chart 3 or 4. The blind chart will be referred to by this name. Chart 1 as referred to in the previous exercise, will serve as a control device.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of chart 3. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written all possible permutations, taken two at a time of the numbers 1 to 9, with a multiplication sign between any two numbers and an equal sign after the second factor. The products are not given. There is one slip of paper for each permutation.

A second basket containing folded slips of paper on which are written all possible combinations, taken two at a time, of the numbers 1 to 9, with an equal sign after the second factor. The products are not given. There is one slip of paper for each combination.

Pencils and square-ruled paper.

DIRECT AIM

To use various forms of multiplication tables in order to have the child memorize the results of the multiplication operations that are contained in these tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Have the child pick a slip of paper from the first basket and copy what is written on it on a sheet of square-ruled paper.
2. He finds the product on chart 3, recording it after the equal sign on his paper. The result of the multiplication is located at the intersection of the column numbered by the first factor with the row numbered by the second factor.
3. The child continues in this manner until he tires of the exercise.
4. Then he checks the results written on his paper by comparing them with those on chart 1, and makes any necessary corrections.

Multiplication

Chart III

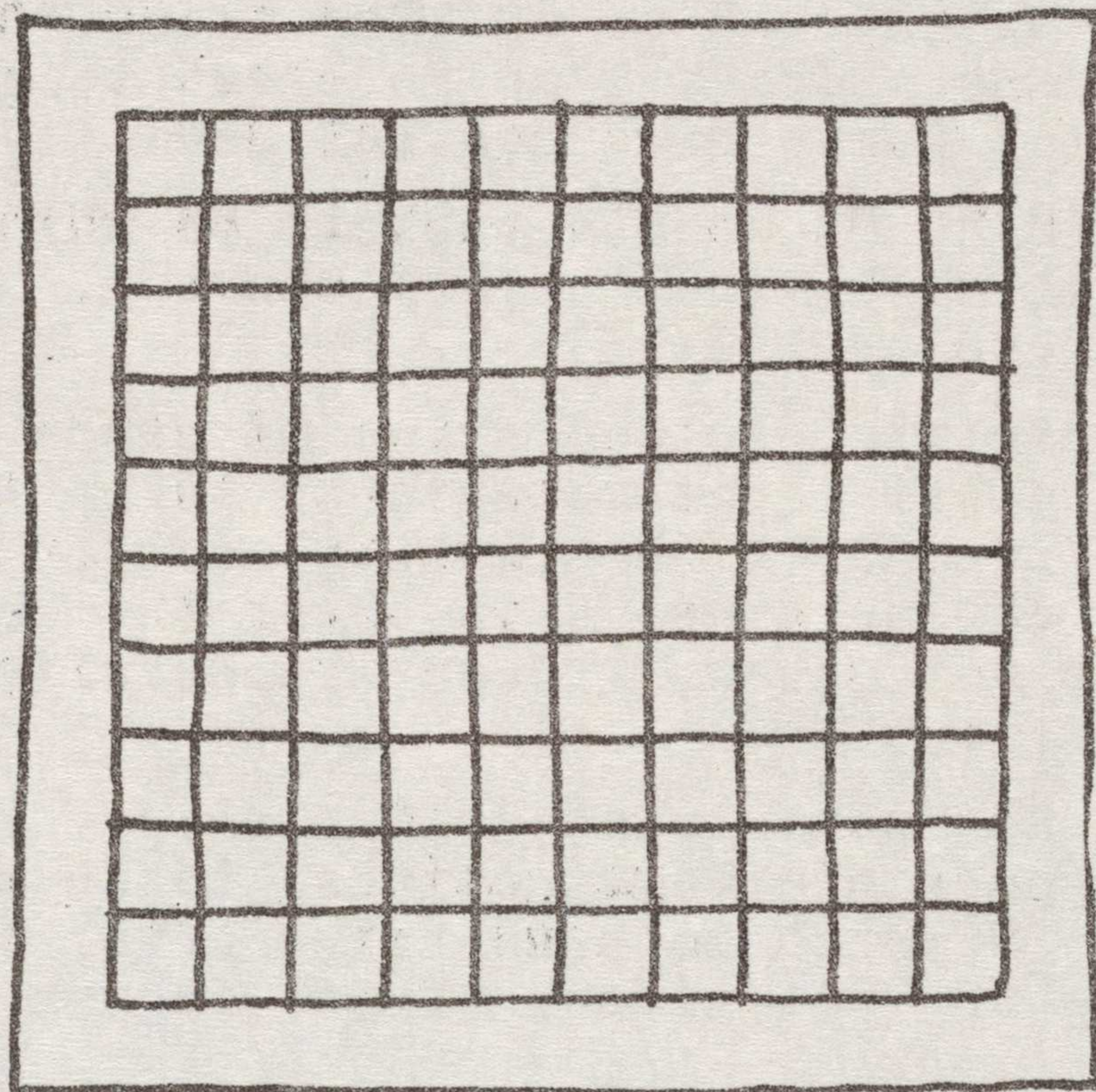
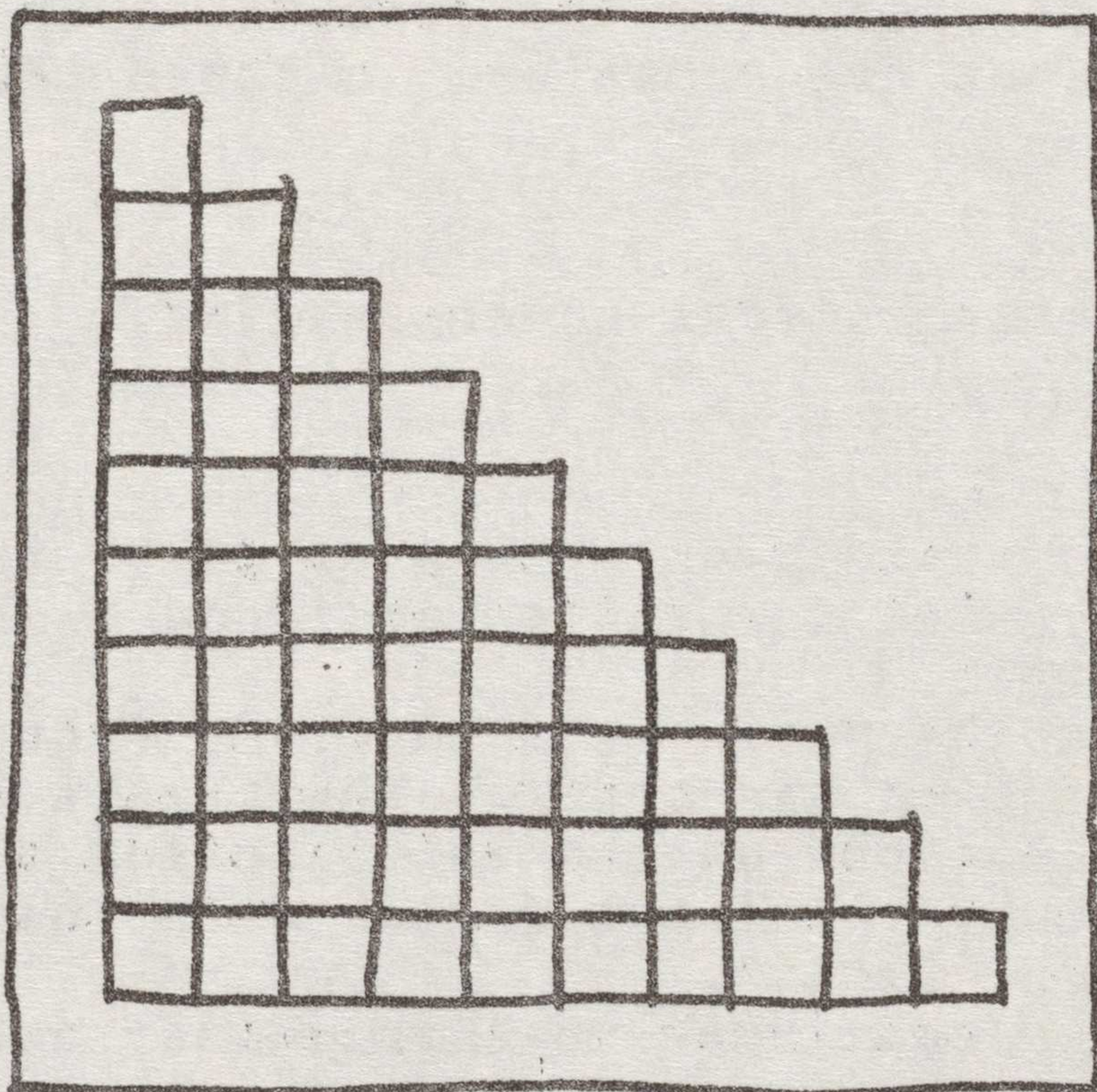


Chart IV



CHARTS - MULTIPLICATION - CONTINUED

LATER EXERCISES

1. Have the child use the second basket in conjunction with charts 4 and 2.
2. Use either basket in conjunction with the blind chart and chart 3 as follows:
 - a) Child picks a slip of paper from either basket;
 - b) mentally solves the product;
 - c) places the tablet that describes this product into the appropriate square on the blind chart;
 - d) after doing many examples the child checks for correctness of results with chart 3.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Charts 1, 2 and 3 and the teacher.



	1	2	3	4	5	6	7	8	9
1	●	●	●	●	●	●	●	●	●
2	●	●	●	●	●	●	●	●	●
3	●	●	●	●	●	●	●	●	●
4	●	●	●	●	●	●	●	●	●
5	●	●	●	●	●	●	●	●	●
6	●	●	●	●	●	●	●	●	●
7	●	●	●	●	●	●	●	●	●
8	●	●	●	●	●	●	●	●	●
9	●	●	●	●	●	●	●	●	●

30	÷	6	=	5
30	÷	5	=	6
	÷		=	
	÷		=	
	÷		=	
	÷		=	
	÷		=	
	÷		=	
	÷		=	



Short Division Board

DIVISION BOARD**MATERIAL**

A wooden board perforated with 81 holes that are arranged in the form of a square. Above the first row of holes in a row of 9 circular grooves that are numbered in sequential order from 1 to 9. The rows of holes are also numbered in sequential order from 1 to 9.

A box that contains 9 small green skittles. A jar of 81 green beads. A division chart prepared by the teacher. A number of sets of 9 slips of paper, each set of which looks as follows:

+9=
+9=
+9=
+9=
+9=
+9=
+9=
+9=
+9=
+9=

+8=
+8=
+8=
+8=
+8=
+8=
+8=
+8=
+8=
+8=

+1=
+1=
+1=
+1=
+1=
+1=
+1=
+1=
+1=
+1=

Pencils

DIRECT AIM

To construct division tables.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Explain to the child that for the purposes of this exercise we are only interested in results without remainders, and not greater than 9.
2. Insert the 9 skittles into the 9 grooves.
3. Take 81 beads and divide them among 9 skittles by inserting them into the 81 holes, 9 beads to each row of holes for 9 rows.
4. Tell the child that you have divide a total of 81 beads evenly among 9 skittles with 9 beads to each skittle and, hence, that there is no remainder. Record the dividend of 81 and the result of 9, which is the number of beads in any column, on the appropriate slip of paper provided for this purpose.
5. Take that smaller number of beads - 72 - that can be divided among 9 skittles so that an equal quantity of beads is allocated to each skittle.

DIVISION BOARD - CONTINUED

6. Tell the child that you have divided a total of 72 beads evenly among 9 skittles with 8 beads to each skittle and, hence, that there is no remainder. Record the dividend of 72 and the result of 8 on the second line of the slip of paper that was used before.
7. Continue finding that total number of beads, smaller than the preceding quantity that can be divided among 9 skittles without remainder until the slip of paper is filled out. Check the recordings with the chart prepared by the teacher.

LATER EXERCISES

1. Clear the board of all beads and remove the skittle from the groove marked with the numeral 9. Explain to the child that the objective now is to find all such quantities of beads that can be divided among 8 skittles without remainders and to record on a second slip of paper these dividends and their respective results.
2. Have the child do this exercise first for 8 skittles, then for 7 skittles, and so on until all 9 slips of paper have been filled out. Ask him to check the recordings with the chart prepared by the teacher.

AGE 5 to 6-1/2 years.

CONTROL OF ERROR

Chart prepared by the teacher and the teacher.

CHARTS - DIVISION

MATERIAL

One division table and one blind chart. See N. Newkirk illustration of the table and attachment for the blind chart.

A box containing 81 wooden tablets on which are printed the same numerals as in the body of the division table. There is one numeral on each tablet.

A basket containing folded slips of paper on which are written all pairs of dividend (81 to 1) and divisor (9 to 1) that will yield results 9 to 1 when the operation of division is performed. There is a division sign in the space between dividend and divisor and an equal sign after the divisor.

Square ruled paper and pencils.

DIRECT AIM

To use a division table in order to have the child memorize the division operations that are contained in the table.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Have the child pick a slip of paper from the basket and copy what is written on it onto a sheet of square ruled paper.
2. Show the child that the result is located on chart 1 at the intersection of the column numbered by the dividend with the row numbered by the divisor. Have the child record the result after the equal sign on his paper.
3. The child continues with the exercise until he tires of it.
4. Then he checks the results written on his paper by comparing them with those on chart 1 and makes any necessary corrections.

LATER EXERCISES

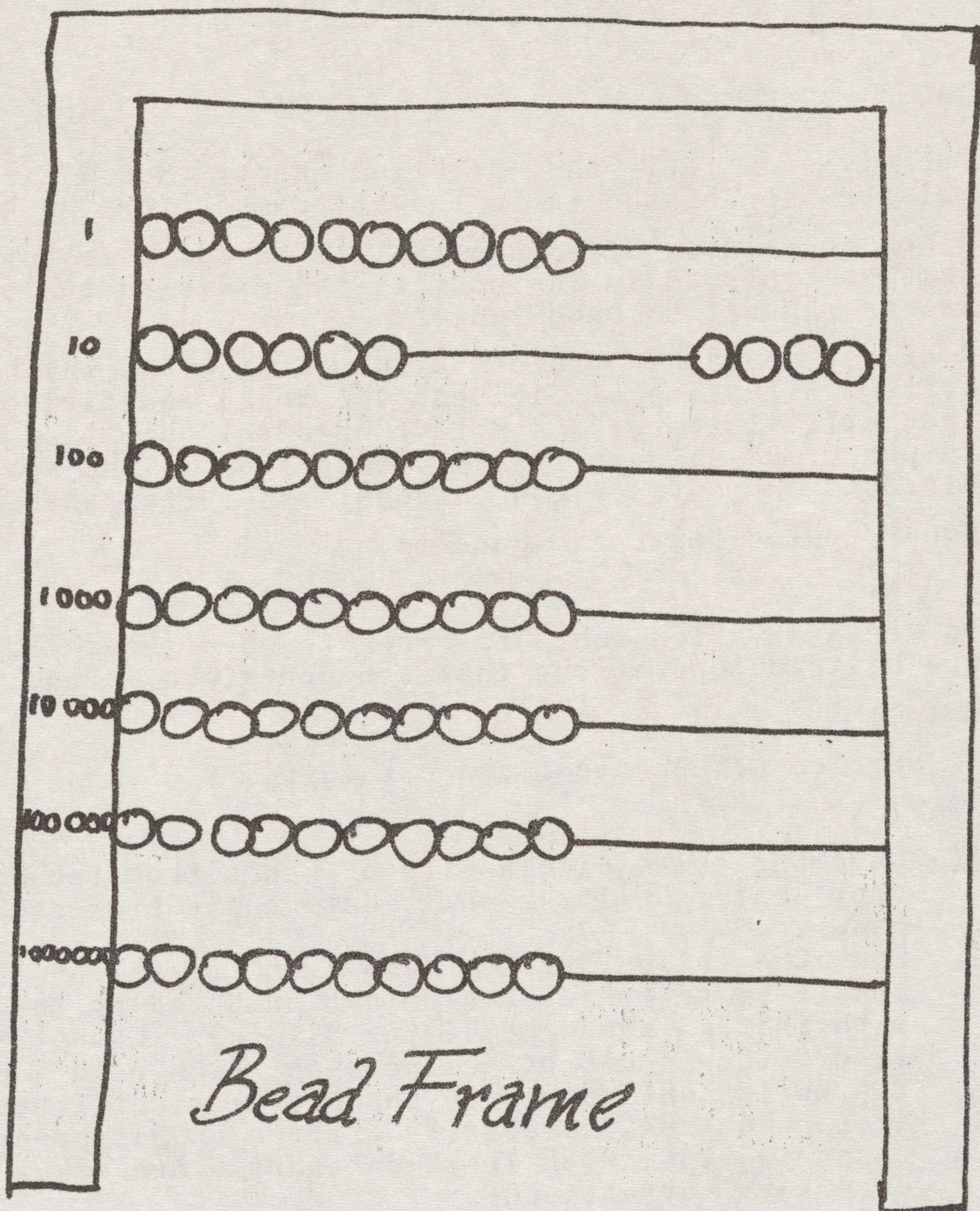
Use the basket in conjunction with the blind chart, tablets and chart 1 as follows:

- a) Child picks a slip of paper from the basket;
- b) mentally solves for the result;
- c) places the tablet that describes the result into the appropriate square on the blind chart;
- d) after doing several examples checks for correctness of results with chart 1.

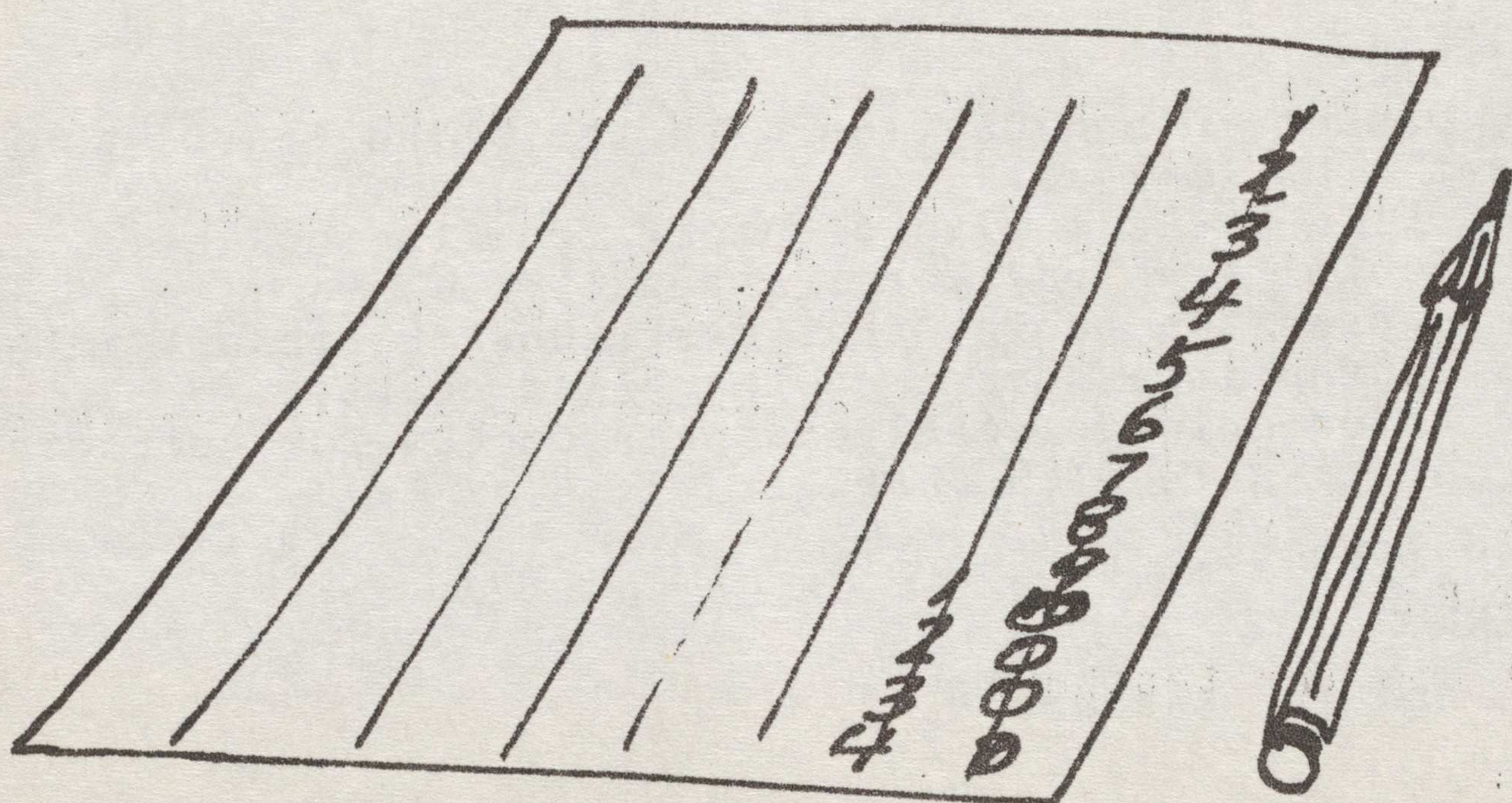
AGE 5 to 7 years.

CONTROL OF ERROR

Chart 1 and the teacher.



Bead Frame



BEAD FRAMES

MATERIAL

A wooden frame with 7 wires stretched across it on each of which are strung 10 colored beads. The wires are numbered from top to bottom by the numerals 1, 10, 100, 1,000, 10,000, 100,000, and 1,000,000. The beads on the 1st wire are green, on the 2d blue and on the 3rd wire red. These colors are repeated in the same sequence for the beads on the next three wires. The beads on the 7th wire are green.

A wooden frame with 4 wires stretched across it on each of which are strung 10 colored beads. The wires are numbered from top to bottom by the numerals 1, 10, 100, and 1,000. The beads on the 1st wire are green, on the 2d blue, on the 3rd red and on the 4th wire green. To distinguish this frame from the preceding one, we shall refer to the latter as the "long frame" and to the former as the "short frame".

Two sets of columnar sheets of paper, one set to be used in conjunction with each frame. The set to be used with the long frame is divided into 8 columns by 7 vertical lines. The lines are labeled from left to right as follows: Millions, Hundreds of Thousands, Tens of Thousands, Units of Thousands, Hundreds, Tens and Units. The paper to be used with the short frame is divided into 5 columns by 4 vertical lines. The lines are labeled from left to right as follows: Units of Thousands, Hundreds, Tens and Units. The vertical lines in both sets of paper are of the same colors as the color of the beads to which they correspond.

DIRECT AIM

To provide the child with further practice in the writing of numerals, in counting, in the operations of addition, subtraction and multiplication - all in preparation for working with numbers in the abstract.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Show the child how to count the beads as follows:
 - a) Using the short frame, slide all beads to the left side of the frame.
 - b) Begin counting the unit beads by sliding one bead at a time to the right side of the frame. As you do so enunciate "one unit", "two units", "three units", and so on.
 - c) When all 10 unit beads have been counted in this manner, slide all 10 beads - as a unit - back to the left side of the frame. Then slide one blue bead from the

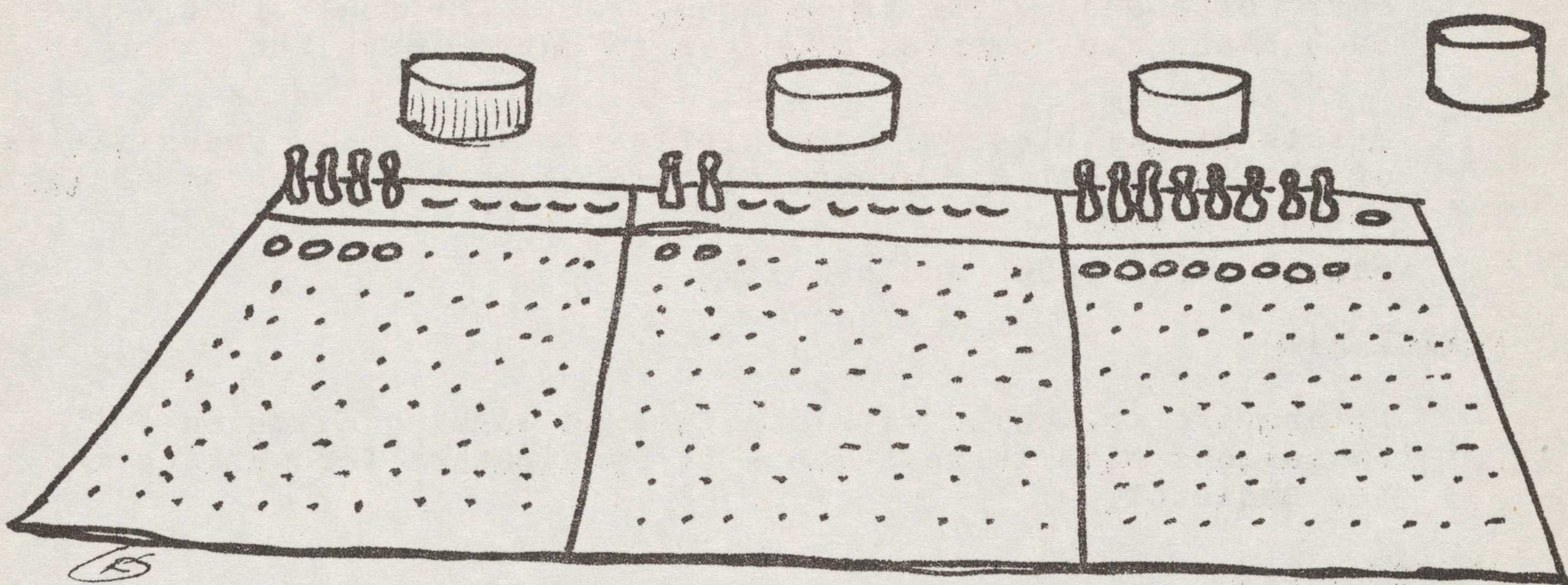
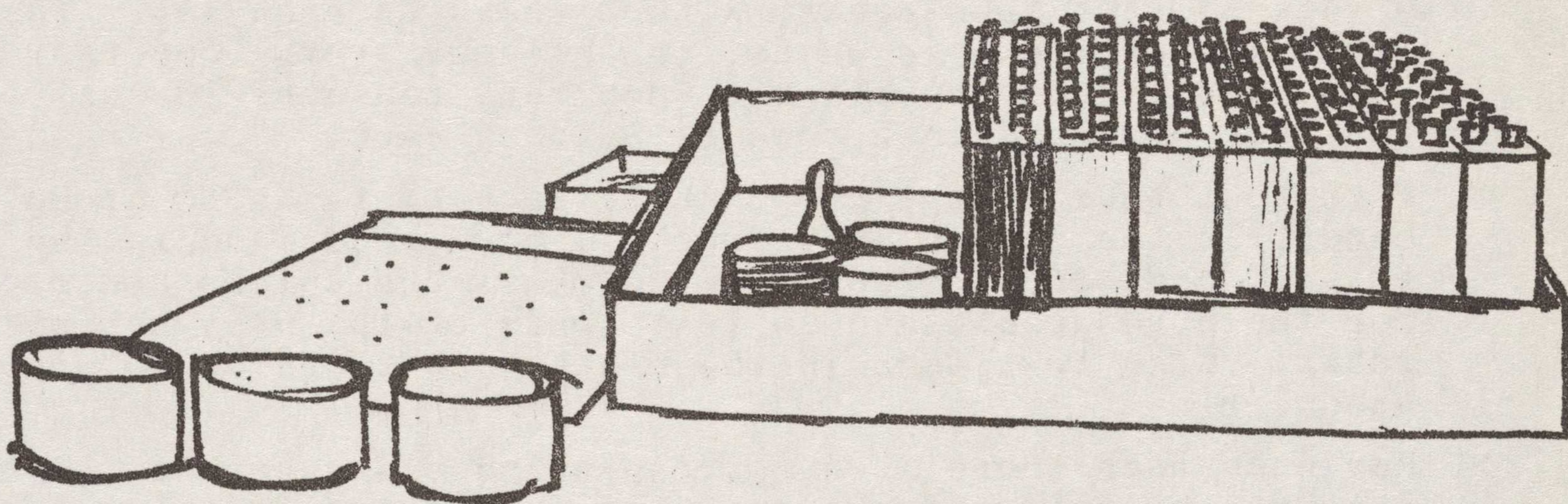
BEAD FRAMES - CONTINUED

- 2d row to the right side of the frame, enunciating - as you do so - "ten units is the same as one ten".
- d) Repeat this process for the 2d row, then 3rd, and 4th rows.
2. Record the counting on the appropriate sheet of columnar paper. Write the units 1 to 9 on the green line labeled "units", the tens - 10 to 90 - below the units on the blue and green lines, the hundreds on the red, blue and green lines and the thousands on all four lines.
 3. Compose a number with the beads by moving them to the right side of the frame. Then record it on the prepared paper, writing the numerals on the appropriate lines as described above.
 4. Perform addition operations as follows:
 - a) Write two addends on the sheet of paper;
 - b) Form the first addend with beads;
 - c) Add the units of the second addend in beads to the units of the first addend, making any necessary exchanges;
 - d) Continue adding the tens, hundreds and thousands, if any, in the same manner;
 - e) Record the total number of beads - the sum - on the paper below the second addend.
 5. Perform subtraction operations as follows:
 - a) Write the sum and first addend on the sheet of paper;
 - b) Form the sum with beads;
 - c) Subtract the number of beads in the first addend starting with the units and making all necessary exchanges;
 - d) Record the second addend - the result of the subtraction operation - on the piece of paper below the first addend.
 6. Perform multiplication operations as follows:
 - a) Write the two factors on the sheet of columnar paper. Assume, for example, that 97 is to be multiplied by 53.
 - b) Mentally solve the product $3 \times 7 = 21$ and form that quantity with beads on the right side of the frame. Record this operation;
 - c) Mentally solve the product $3 \times 90 = 270$ and add this quantity in beads to the 21 beads. Record this operation;
 - d) Mentally solve the product $5 \times 70 = 350$ and add this quantity in beads. Record this operation;
 - e) Mentally solve the product $5 \times 900 = 4500$ and add this quantity in beads. Record this operation;
 - f) Count the total number of beads on the right side of the frame and record this product - 5141 - below the factor 53 on the columnar paper.

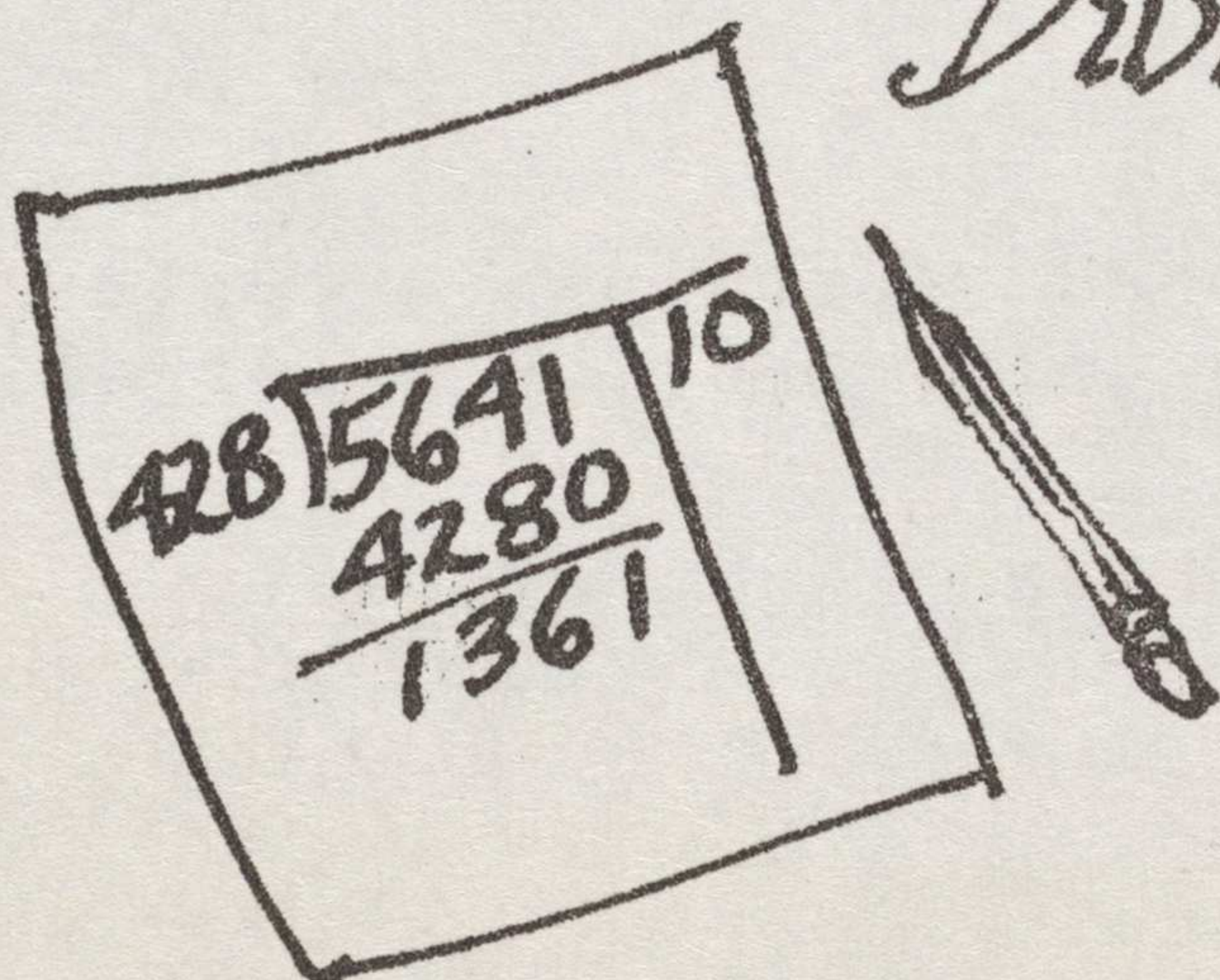
LATER EXERCISES Do the same exercises on the long frame using larger numbers.

AGE 6 to 7 years.

CONTROL OF ERROR The teacher.



Division with Beads & Boards



DIVISION WITH BEADS AND BOARDS

MATERIAL

2 sets of test tube racks, with 3 racks to each set. The first set of racks is white, the second grey. One test tube rack that is colored black. Each rack contains 10 test tubes that are arranged in 2 rows of 5 tubes each.

Each test tube in the first white rack contains 10 green beads, in the second white rack 10 blue beads and in the third rack 10 red beads. These same numbers and colors are repeated for the beads contained in test tubes of the grey set of racks. Each test tube in the black rack contains 10 green beads.

For each rack there is a corresponding dish, painted on the outside the color of the rack and on the inside the color of the beads that are in the test tubes of that rack.

3 wooden boards, each perforated with 81 holes that are arranged in the form of a square. Above the first row of holes, for each board, is a row of 9 circular grooves that are numbered in the sequential order from 1 to 9. The background for the grooves on the first board is green, on the second board blue and on the third board red. The rows of holes in each board are numbered from top to bottom with the numerals 1 to 9.

3 sets of skittles, with 9 skittles to each set. The skittles of the first set are green, of the second set blue and of the third set red.

Square ruled paper and pencils.

DIRECT AIM

To provide the child with practice in working division operations with large numbers in preparation for working in the abstract.

INDIRECT AIM

To develop mathematical understanding.

PRESENTATION

1. Explain to the child that one bead represents a certain quantity depending upon its own color and the color of the rack as follows:

<u>color of rack</u>	<u>color of bead</u>	<u>quantity</u>
black	green	1,000,000
grey	red	100,000
grey	blue	10,000
grey	green	1,000
white	red	100
white	blue	10
white	green	1

DIVISION OF BEADS AND BOARDS - CONTINUED

Explain also that the board with the red top is to be used in conjunction with the red skittles, each of which represents 100; the blue-topped board with blue skittles, each of which represents 10; and the green-topped board with the green skittles, each of which represents 1.

Note: The presentation of the material will be explained by use of an example. While the numbers in an actual situation should be larger than the ones chosen here, the principles of presentation are the same.

2. Choose a dividend and a divisor. For the purpose of the present demonstration, let these be 785 and 23, respectively.
3. Select the 3 dishes that are painted white on the outside and put 7 red beads into the dish that is painted red on the inside, 8 blue beads into the dish that is blue on the inside, and 5 green beads into the dish that is painted green on the inside. All beads must come from the test tubes of the white racks.
4. Select the blue-topped and the green-topped boards and insert 2 blue skittles into the circular grooves of the latter. (The blue-topped board will be referred to hereafter as the "1st board" and the greentopped board as the "2nd board".)
5. Place the dish containing the 7 red beads immediately above the 1st board and the dish with 8 blue beads above the 2nd board.
6. Now divide the beads among the skittles by inserting 3 blue beads into the 2nd board for every 2 red beads that have been inserted into the holes of the 1st board. Continue this pattern of distribution until the number of red beads that remain is less than the number of skittles on the 1st board. Before this point is reached, you may find that the number of green beads is exhausted. In that case, exchange 1 red bead for 10 blue beads and continue the distribution. In the present case, for example, you will find that 3 rows of 2 red beads each are placed on the 1st board, 3 rows of 3 blue beads each are placed on the 2nd board, one exchange of 1 red bead for 10 blue beads is made and that 9 blue beads remain undistributed.
7. Count the number of beads that have been distributed to any one of the skittles on the 2nd board. Since in this case the number is 3 and each blue bead represents the quantity of 10, record 30 as illustrated in the numerical recap below.
8. Count the quantity represented by the beads on the 2 boards. Record this number - 690 in the present case - similarly as illustrated below.
9. Clear the beads from the boards.
10. Continue dividing the remaining beads - in this case 95 - using the same procedure that was described above. Also record the 95 remaining beads as illustrated below.

DIVISION OF BEADS AND BOARDS - CONTINUED

11. When this distribution is completed, you will find that 4 rows of 2 blue beads each are placed onto the 1st board, 4 rows of 3 green beads each are placed on the 2d board, one exchange of 1 blue bead for 10 green beads is made and that 3 green beads remain undistributed.
12. Count the number of beads that have been distributed to any one of the skittles on the 2d board. Since in this case the number is 4 and each green bead represents the quantity of 1, record 4 as illustrated below.
13. Count the quantity represented by the beads on the 2 boards. Record this number - 92 in the present case - as illustrated below. Also record the remainder of 3.
14. Now find the total quantity that represents the result of the division operation by adding 30 and 4 as shown below.

Numerical recap:

23)785	30
690	
95	4
92	
3	34 r. 3

LATER EXERCISES

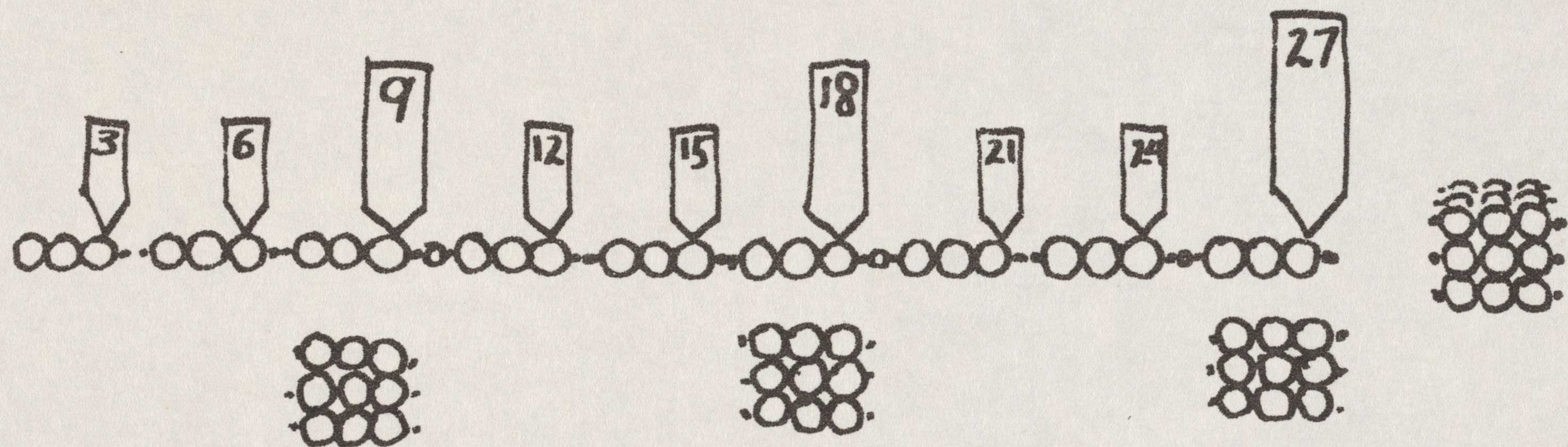
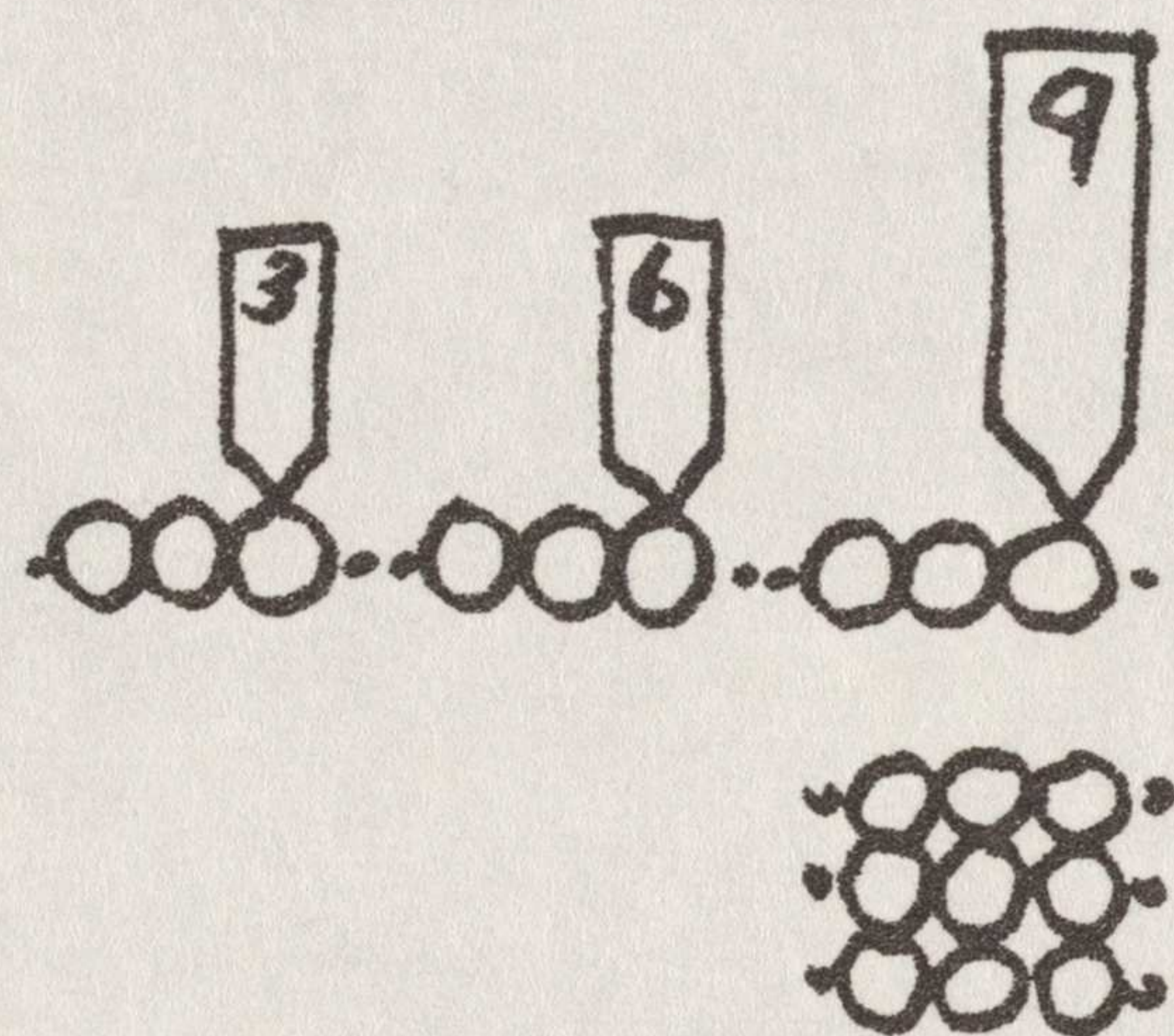
Employ larger numbers for both dividend and divisor.

AGE 6-1/2 to 7 years.

CONTROL OF ERROR

The teacher.

Squares & Cubes of Numbers



LANGUAGE

BY

MARY FLYNN EYDT

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ILLUSTRATIONS BY
ROBERT SAVOYE
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OUTLINE

- I. ORAL LANGUAGE--RECEPTIVE AND EXPRESSIVE
 - A. STORY TELLING, POETRY
 - 1. Techniques
 - 2. Suggested children's books
 - 3. Poetry selections
 - 4. Poetry bibliography
 - B. USE OF PICTURE STORY PAPER
 - C. USE OF EXPERIENCE CHARTS, WORK CHARTS
 - D. VOCABULARY
 - 1. Vocabulary development
 - 2. Vocabulary check list
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 - E. FOLLOWING ORAL DIRECTIONS
 - F. LANGUAGE PATTERNING
 - G. FURTHER DEVELOPMENT OF EXPRESSIVE LANGUAGE
- II. PREPARATION FOR READING
 - A. ALPHABET MASTERY--SANDPAPER LETTERS
 - B. MATCHING EXERCISES
 - 1. Picture matching
 - 2. Matching letter clusters
 - C. RHYMING
 - D. LISTENING TO INITIAL CONSONANT SOUNDS
 - E. NAMING CONSONANT SOUNDS--SOUND-SYMBOL CORRESPONDENCE
 - F. SUGGESTED LIST OF OBJECTS FOR OBJECT BOXES
 - G. NAME RECOGNITION
- III. BEGINNINGS OF READING
 - A. INTRODUCTION OF WORD PATTERNS
 - B. INTRODUCTION OF NECESSARY SIGHT VOCABULARY
 - C. SENTENCES AND STORIES
- IV. WRITING
 - A. PREPARATION
 - 1. Sandpaper letters
 - 2. Metal Insets
 - B. PRACTICE
 - 1. Use of blackboard and large sheets of paper
 - 2. Practice sheets
 - 3. Structured paper
 - 4. Name booklets

I. ORAL LANGUAGE

A. STORY TELLING, POETRY READING

1. TECHNIQUES

Techniques of story telling and poetry reading
will be demonstrated and discussed in class.

Insert classroom notes.

SUGGESTED CHILDREN'S BOOKS

Anecdoted additions to this very limited list will be prepared by the trainees during the summer.

THE CARROT SEED -- Ruth Krauss, Illus. Crockett Johnson
Harper & Row, 1945

THE BUNDLE BOOK -- Ruth Krauss, Illus. Helen Stone
Harper & Bros., 1951

THE LITTLE FAMILY -- Lois Lenski
Doubleday & Co., 1932

EVERYBODY EATS -- Mary McBurney Green, Illus. Louis Klein
Young Scott, 1961

EVERYBODY HAS A HOUSE -- Mary McBurney Green, Illus. Louis Klein
Young Scott Book, 1961

FIRST THINGS -- Designed by George A. Adams
Platt & Munk Co, 1947

CURIOUS GEORGE -- H. A. Rey
Houghton Millflin Co., 1941

THE HAPPY LION -- Louise Fatio, Illus. Roger Duvoisin
Whittlesey (McGraw-Hill), 1954

THE STORY OF BABAR -- Jean De Brunhoff
Random House, 1960

CAPS FOR SALE -- Esphyr Slobodkina
William R. Scott, 1962

WAKE UP, FARM -- Alvin Tresselt, Illus. Roger Duvoisin
Lothrop, Lee & Shepard, N.Y., 1955

BIG RED BUS -- Ethel & Leonard Kessler
Doubleday & Co., 1957

ALL ABOUT DOGS, DOGS, DOGS -- Grace Skaar
Young Scott, 1957

POETRY SELECTIONS

WATERS

Sprinkling,
Wrinkling,
Softly tinkling
Twinkly
Tiny brook,
Running
Hiding
Sunning
Cunning baby brook,
Joins a grown up brook.
Dashing
Splashing,
Sunlight flashing,
Stony grown up brook
Joins the river
Broad smooth river
Deep as deep can be.
Slower,
Slower,
Slower,
Flowing
Wider
Wider
Wider
Growing
Till it empties all the waters
out into the great huge sea.
Rolling,
Rolling,
Tossing,
Rolling,
Splashing waves forever
rolling in the great wide
sea.

Edith H. Newlin
VERY YOUNG VERSES
Houghton Mifflin Company

Selected by
Mrs. John Chabria

The black cat yawns,
Opens her jaws,
Stretches her legs,
And shows her claws.

Then she gets up
And stands on four
Long stiff legs
And yawns some more.

She shows her sharp teeth
She stretches her lip,
Her slice of a tongue
Turns up at the tip.

Lifting herself
On delicate toes
She arches her back
As high as it goes.

She lets herself down
With particular care,
And pads away
With her tail in the air.

M.B. Miller
MENAGERIE
The Macmillan Co.

WHO HAS SEEN THE WIND?

Who has seen the wind?
Neither I nor you:
But when the leaves hang trembling,
The wind is passing through.
Who has seen the wind?
Neither you nor I:
But when the trees bow down their heads
The wind is passing by.

Christina G. Rossetti
SING-SONG
The Macmillan Company

Mrs. Chabria

A SECRET

We have a secret,
 just we three,
 The robin and I,
 and the sweet cherry tree;
 The bird told the tree
 and the tree told me,
 And nobody knows it
 but just we three.

And of course,
 the robin knows it best.
 Because she built the _____,
 I shan't tell the rest;
 And laid the four
 little somethings in it _____
 I am afraid
 I shall tell it every minute.

UNKNOWN

AEROPLANE

There's a humming in the sky
 There's a shining in the sky
 Silver wings are flashing by
 Silver wings are shining by
 Aeroplane
 Aeroplane
 Flying -- high

Silver wings are shining
 As it goes gliding by
 First it zooms
 And it booms
 Then it buzzes in the sky
 Then its song is just a drumming
 A soft little humming
 Strumming
 Strumming.

The wings are very little things
 The silver shine is gone
 Just a little black speck
 Away down the sky
 With a soft little strumming
 And a far-away humming
 Aeroplane
 Aeroplane
 Gone -- by.

Mary McB. Green
 ANOTHER HEAR AND NOW STORY BOOK
 E. P. Dutton & Co., Copyright 1937

IN THE SKY

The sky was dark
 with fanning wings
 As flocks of birds
 sailed by --

White wings,
 Gray wings,
 Black against the sky.

Pigeon wings,
 Hawk wings
 Diving through the air;

Eagle wings,
 Bat wings,
 Wings were everywhere.

At times the wings
 blacked out the sun --
 Wild geese were sailing
 high --

White wings,
 Gray wings,
 Black against the sky.

Louise Abney
 ON THE TRAIL OF ADVENTURE
 Laidlaw Basic Reader
 Book IV

GRIZZLY BEAR

If you ever, ever meet a grizzly
 bear
 You must never, never, never ask
 him where
 He is going, or what he is doing.
 For if you ever, ever dare
 To stop a grizzly bear
 You will never meet another
 grizzly bear.

UNKNOWN.

THE KING'S BREAKFAST

The King asked
 The Queen, and
 The Queen asked
 The Dairymaid:
 "Could we have some
 butter for
 The Royal slice of bread?"
 The Queen asked
 The Dairymaid,
 The Dairymaid
 Said,
 "Certainly,
 I'll go and tell
 The cow
 Now
 Before she goes to bed."

The Dairymaid
 She curtsied,
 And went and told
 The Alderney:
 "Don't forget the butter for
 The Royal slice of bread."
 The Alderney
 Said sleepily:
 "You'd better tell
 His Majesty
 That many people nowadays
 Like marmalade
 Instead."

The Dairymaid
 Said,
 "Fancy!"
 And went to
 Her Majesty
 She curtsied to the Queen, and
 She turned a little red:
 "Excuse me,
 Your Majesty,
 For taking of
 The liberty,
 But marmalade is tasty, if
 It's very
 Thickly
 Spread."

The Queen said
 "Oh!"
 And went to
 His Majesty:
 "Talking of the butter for
 The Royal slice of bread,
 Many people
 Think that
 Marmalade
 Is nicer.
 Would you like to try a little
 Marmalade
 Instead?"

"Bother!"
 And then he said,
 "Oh, deary me!"
 The King sobbed,
 "Oh, deary me!"
 And went back to bed.
 "Nobody,"
 He whimpered,
 "Could call me
 A fussy man;
 I only want
 A little bit
 Of butter for
 My bread."

The Queen said,
 "There, there!"
 And went to
 The Dairymaid.
 The Dairymaid
 Said,
 "There, there!"
 And went to the shed.
 The cow said,
 "There, there!"
 I didn't really
 Mean it:
 Here's milk for his porringer
 And butter for his bread."

The Queen took
 The butter
 And brought it to
 His Majesty;
 The King said,
 "Butter, eh?"
 And bounced out of bed.
 "Nobody,"

he said,
 As he kissed her
 Tenderly,
 "Nobody,"

he said,
 As he slid down
 The banisters.

"Nobody,
 My darling
 Could call me
 A fussy man --
 BUT
 I DO LIKE A LITTLE BIT OF
 BUTTER TO MY BREAD!"

He did like a little bit of
 butter to his bread!

A. A. Milne
 WHEN WE WERE VERY YOUNG
 Copyright 1924 by
 E. P. Dutton & Co., Inc.

OLD FAITHFUL

I have an old clock that has hung on the wall,
Tick, tock, a-tickity tock.
So long that I wonder how soon it will fall,
Tick, tock, a-tickity tock.
Hour by hour it ticks away
Tick, tock, a-tickity tock.
Telling the time both night and day,
Tick, tock, a-tickity tock.
It never gets tired, it never complains
Tick, tock, a-tickity tock.
It never gets sick, never loses or gains,
Tick, tock, a-tickity tock.
How does it know when it's time to get up?
Tick, tock, a-tickity tock.
This morning I know that it said, "Hurry up!"
Tick, tock, a-tickity tock.
If ever a friend could be faithful and true,
Tick, tock, a-tickity tock,
As this one has been, I hope it is you,
Tick, tock, a-tickity tock.

Conrad F. Wedberg.

JUMP OR JIGGLE

Frogs jump
Caterpillars hump

Worms wiggle
Bugs jiggle

Rabbits hop
Horses clop

Snakes slide
Seagulls glide

Mice creep
Deer leap

Puppies bounce
Kittens pounce

Lions stalk
But I walk

Evelyn Beyer
ANOTHER HERE AND NOW STORY BOOK
E.P. Dutton & Co., Inc.
Copyright 1937.

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Prepared by
Miss Bernice McLaren

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McEwen, Catherine S.

AWAY WE GO 100 POEMS FOR THE VERY YOUNG. Cromwell. 1946

**Opie, Iona and Peter

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Scotland, Andrew

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*NOW WE ARE SIX. (Rev. ed) Dutton. 1961

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Petersham, Maud.

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**Moore, Clement C. Illus. by Grandma Moses

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Lear, Edward

***NONSENSE ALPHABET. Doubleday. 1961 \$1.75

Sendak, Maurice. (4 "teeny-tiny" books - delightful)

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WIDE AWAKE. Harcourt & Brace. 1959

Smith.
*THE BIG LITTLE BOOK. Golden-Press. 1962

Fisher, Aileen (beautifully illus.)
*I LIKE WEATHER. Thomas Crowell. 1963

McFarland, W.
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***VERY YOUNG VERSES. Houghton, 1945

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Einsel, Walter.
DID YOU EVER SEE? Young Scott. 1962 \$3.00

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THE SILLY BOOK. Harper. 1961 \$1.50

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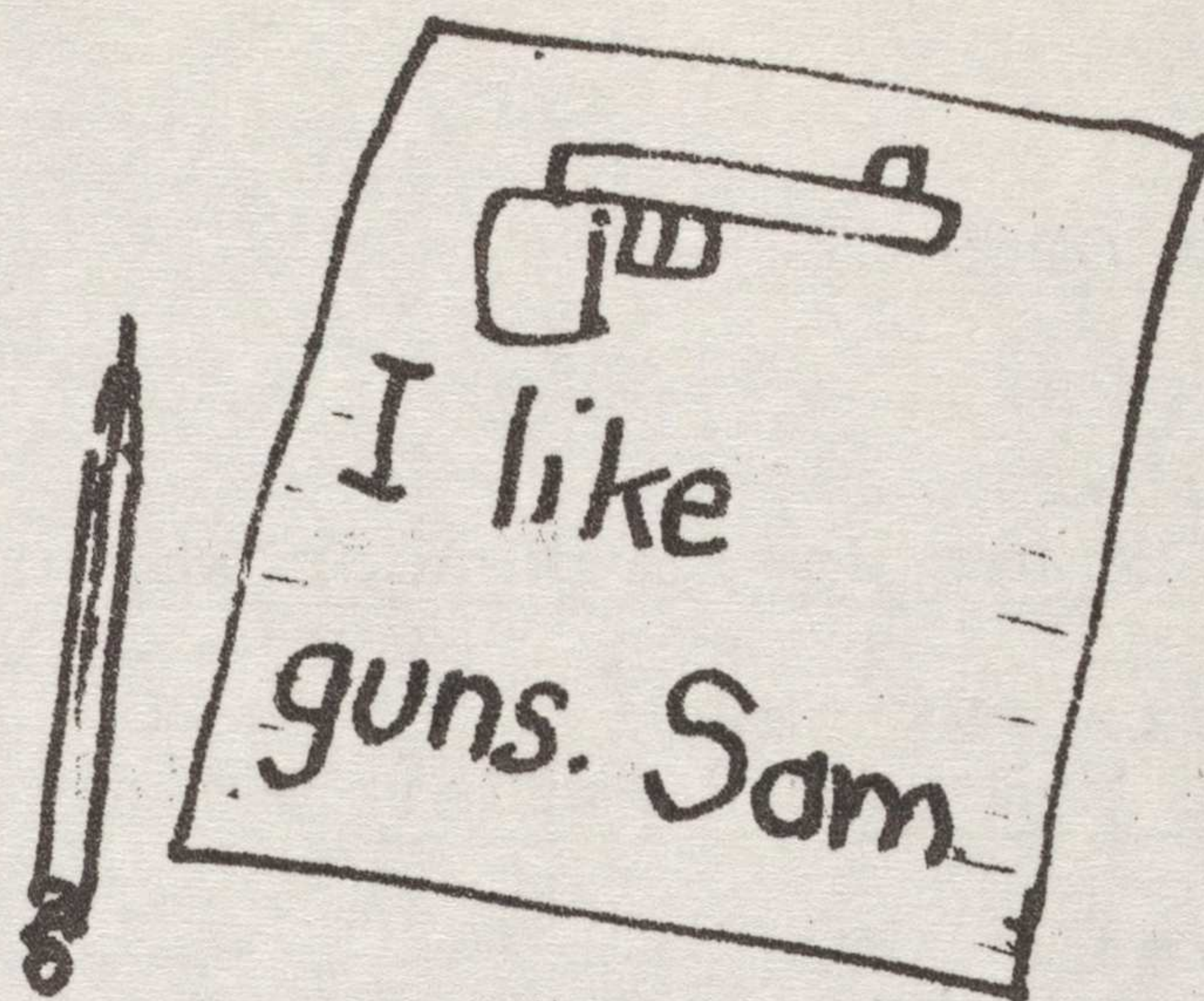
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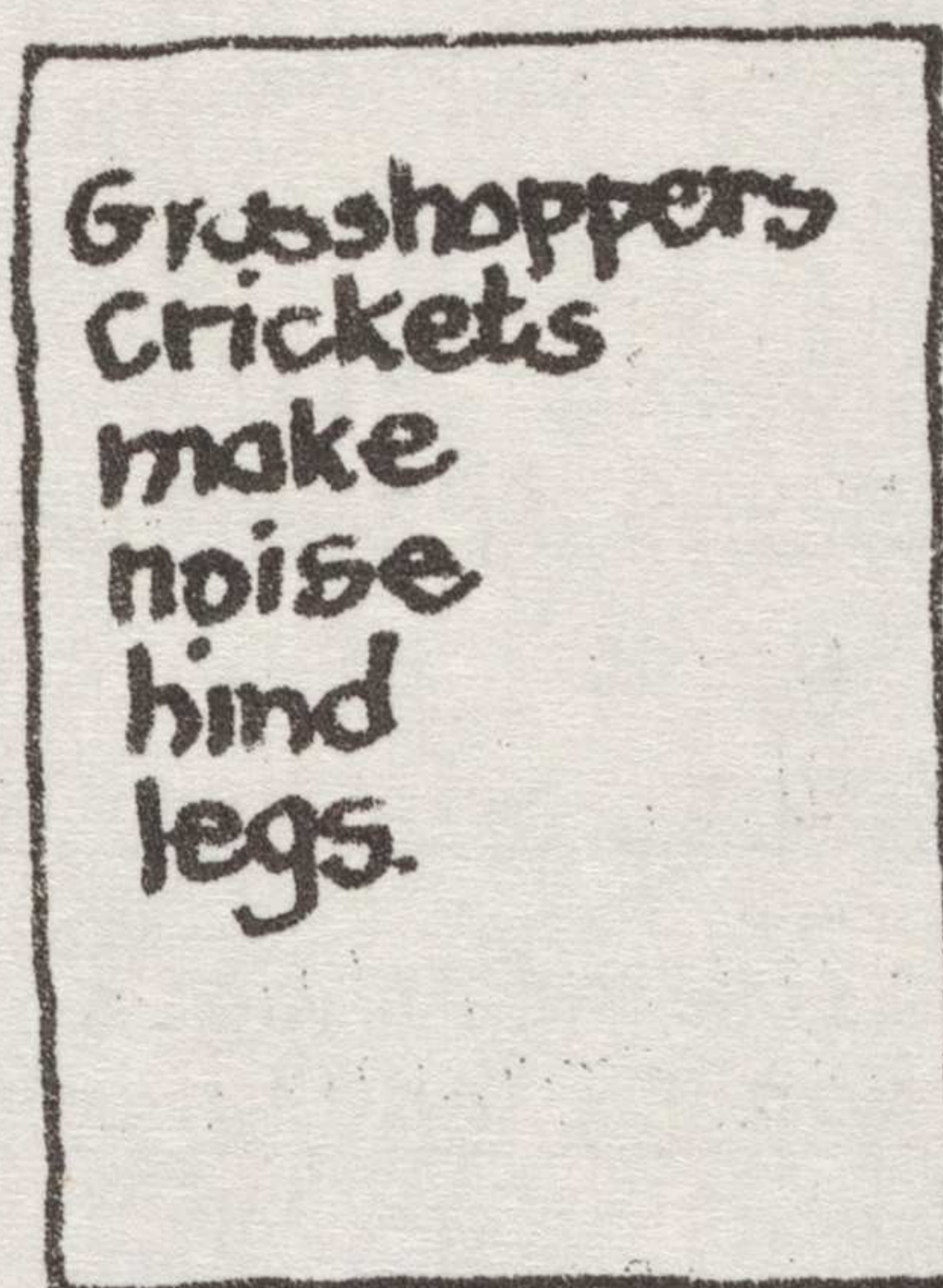
Ciardi, J

*The Pelican and other poems.

Picture Story Paper



Experience Chart



ORAL LANGUAGE

B. USE OF PICTURE STORY PAPER

PURPOSE

1. Develops expressive language or part of child.
2. Indirect preparation for reading--child sees oral language translated into abstract symbols.

MATERIALS *

Sheets of paper with ruled guide lines and space left at the top for a picture to be drawn or pasted in.

PROCEDURE

The child can draw, crayon, use magic marker, or paste his picture in the top space. Teacher then asks her to tell her something about the picture or if there is a story that goes with the picture. The teacher writes down the child's remarks, forming the letters properly and providing a good model for future writing by the child. The teacher can read the story or remarks back to the child and it can be displayed in the classroom.

- * Picture-story paper is commercially available through school supply houses.

ORAL LANGUAGEC. USE OF EXPERIENCE CHARTS

PURPOSE Same as picture story paper. In addition,
 3. Beginnings of paragraph organization
 4. Introduction to punctuation

MATERIALS--Large sheets of lined paper or oak tag which can be used later on easel, chart stand, or bulletin board.

PROCEDURE--Large experience charts are usually used with a group. They are usually constructed after a group experience and/or before one--e.g. a trip, classroom occurrence, science lesson, etc. The class discusses the event and the teacher can put down the key words on the blackboard. After the discussion has been stimulated and contributions made the teacher says, "Now we are going to write down what has happened. These words may help us." The teacher arranges sentences with the children's help and writes them on the chart. She indents the paragraph, leaving room at the top for a title to be added later. She should write clearly, without fault, providing a proper model for the child. The story can be displayed and re-read in the future to individuals or group if interest is shown.

Smaller versions of experience charts may be done with individuals if the occasion arises.

ADDITIONAL Work charts are a type of experience chart. See the illustration for some suggestions.

The teacher can take advantage of many opportunities which arise for translating oral language into written language in front of the child, e.g. writing a child's name on his work, writing down a title or brief description a child might give of his drawing. At all times, she should be careful to provide a correct model for the child, forming letters carefully in the proper directional sequence.

Jobs for the week



Serving Juice William



Serving Cookies Anne



feeding the fish Toby

March						
Sun	Mon	Tue	Wed	Th	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			
Today is Monday						
It is Cold and Wet						

Work
Charts

Yes

No

Magnet

1. Does a magnet attract a pin? 
 2. Does a magnet attract a pencil? 
 3. Does a magnet attract paper? 
 4. Does a magnet attract a nail? 
- etc.

ORAL LANGUAGED. VOCABULARY1. VOCABULARY DEVELOPMENTPURPOSE

To enlarge the child's vocabulary, and to help in his classification of the environment.

MATERIALS

The objects in the environment
 Sensorial apparatus
 Collection of pictures of objects in various categories--fruit, vegetables, household, animals, occupations, etc.

PRESENTATION

The children should know the correct name for all the objects in the room, particularly those with similar names, e.g. broom, brush. If necessary, the teacher can teach the names of the materials and other objects in a three period lesson. She can then play group games, asking the children to bring her this or that until the names are firmly established.

The vocabulary of the sensorial apparatus should be taught by means of a three period lesson.

Cylinders--thick, thin, deep, shallow, tall, short

Pink tower--large, small, big, little

Thermic--hot, cold

Tactile boards--rough, smooth

Red rods--long, short

Brown stair--broad, narrow

Bells--high, low

Colors--names, light, dark

Taste jars--sweet, bitter, sour, salty

Baric tablets--heavy, light

Also comparatives and superlatives

The names of the geometric and biological insets can also be taught.

With the sets of pictures both group and individual games may be played. The teacher or child holds up a card and the child or children says the name. Any names not known are taught by means of the 3 period lesson.

Classification

Mix two sets and then let the child separate the pictures and group the ones belonging together.

Additional

See section on Oral Directions for the teaching of vocabulary dealing with place and spatial relationship.

ORAL LANGUAGE - VOCABULARY2. VOCABULARY CHECK LIST

The following check list was prepared to evaluate the disadvantaged child's responses to the spoken word. It is intended to give one a general idea of the categories one can develop in regards to specific vocabulary lessons.

<u>COLOR</u>		<u>SHAPE</u>	<u>SIZE</u>	<u>NUMBER</u>
Blue		Circle	Long	One
White		Square	Large	Two
Red		Round	Little	Three
Green		Triangle	Short	Four
Yellow		Cross	Biggest	
Brown		Star	Smallest	
Black			Bigger	
			Smaller	
			Longer	
			Shorter	
			Tallest	
			Shortest	

<u>SERIAL ORDER</u>	<u>TIME SEQUENCE</u>	<u>LOCATION AND DIRECTION</u>		<u>COMPARISON</u>
First	Then	Under	Next (to)	Alike
Second	First	On	Down	Different
Third	Later	In	Behind	Same
Last	Before	Over	Here	Wet
Next	Now	Through	Up	Dry
	After	From		Rough
	Today	To		Smooth
	Soon	Left		Warm
		Right		Cold
		Top		High
		Middle		Low
		Bottom		Clean
		Front		Dirty
				New
				Old

<u>PARTS OF BODY</u>		<u>FAMILY RELATIONSHIPS</u>		<u>ANIMALS</u>	<u>FRUITS</u>
Eye	Foot	Baby	Boy	Animals	Apple
Hand	Head	Mother	Girl	Bird	Orange
Finger	Arm	Father		Dog	Pear
Nose	Shoulder	Grand-father		Cow	Peach
	Leg	Grand-mother		Horse	
		Family		Sheep	
				Lamb	
				Chicken	
				Pig	

ORAL LANGUAGE - VOCABULARYVOCABULARY CHECK LIST (CONTINUED)

<u>TOYS</u>	<u>CLOTHING</u>	<u>HOUSEHOLD</u>	<u>PRONOUNS</u>	<u>MISCELLANEOUS</u>
Block	Shoe	Table	He	Not
Ball	Sock	Book	We	And
Boat	Glove	Bed	She	Or
Plane	Shirt	Clock	They	Other
Bicycle	Dress	Spoon	You	Both
Doll	Hat	Bottle	These	All
Kite	Umbrella	Bell	Those	With
Skates		Fork	Which	Another
Paint		Knife		Box
Wagon		Soap		Letter
		Window		Page
		Food		Line
		Cup		Row
		Saucer		Pair
		Picture		
		Kitchen		
		Towel		
		Car		

ORAL LANGUAGE - VOCABULARY3. MULTIPLE MEANINGS OF WORDSPURPOSE

To extend the child's vocabulary by teaching him the various meanings of a single word and their appropriate use.

MATERIALS

Sets of picture cards illustrating the various meanings of individual words.

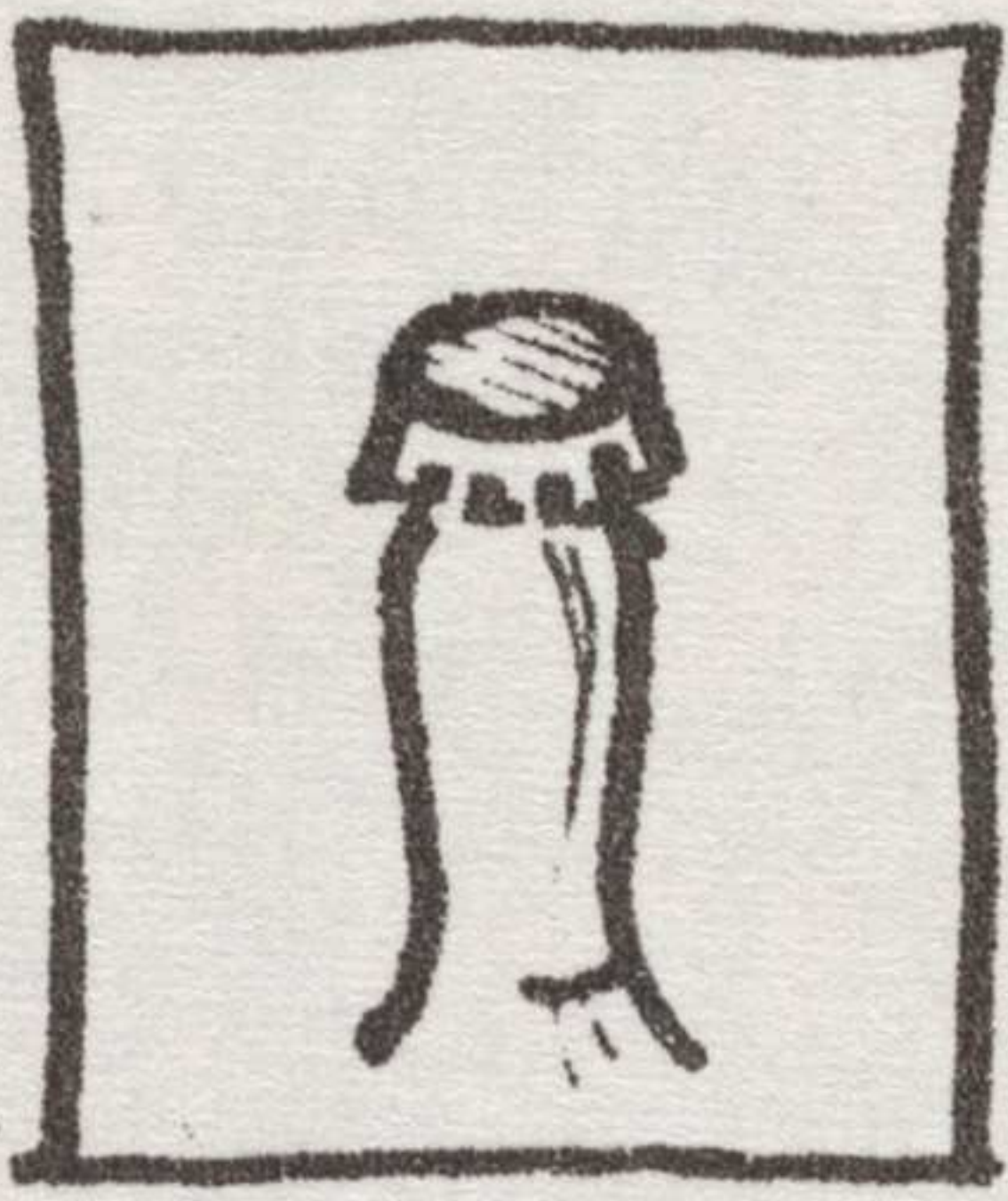
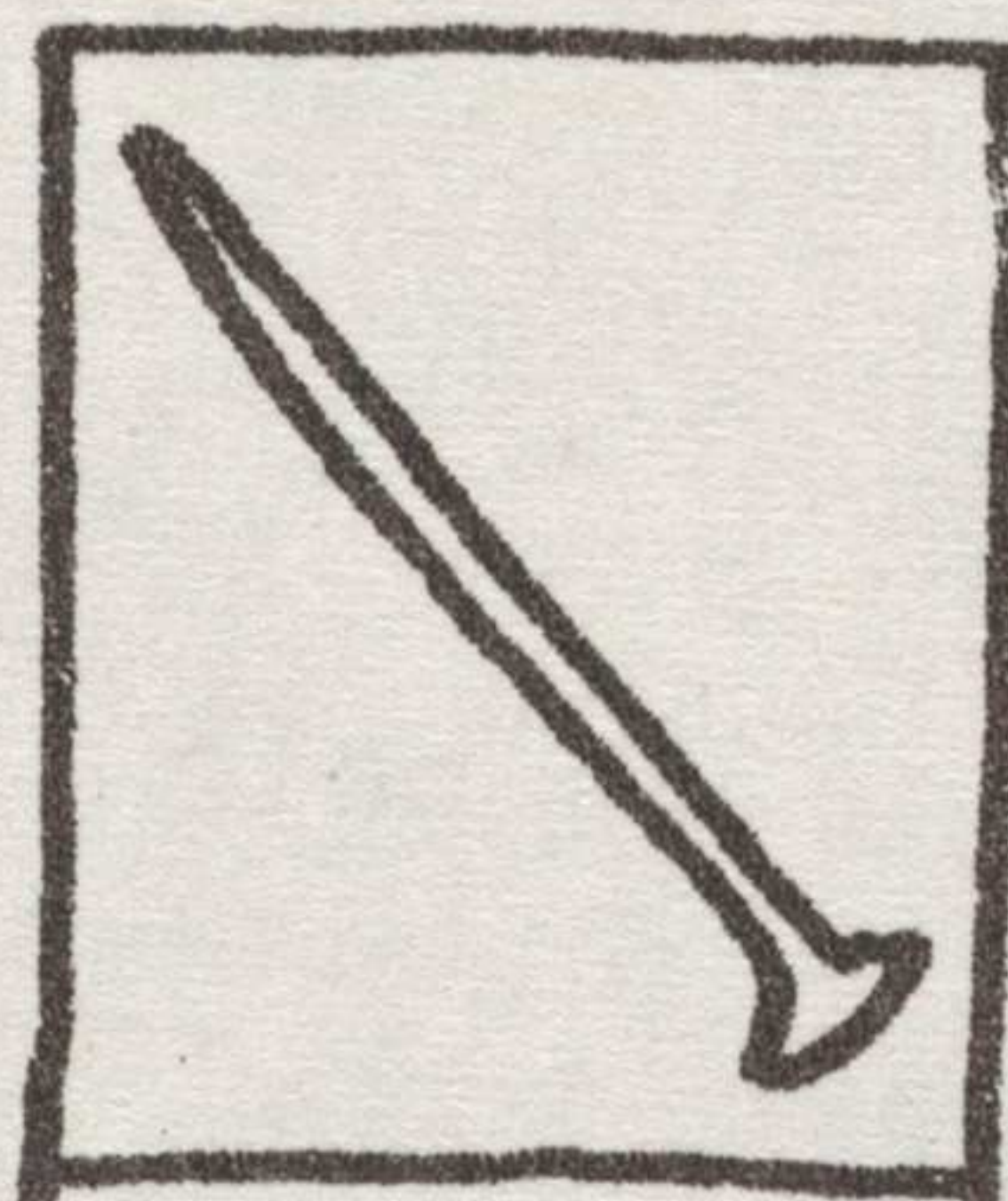
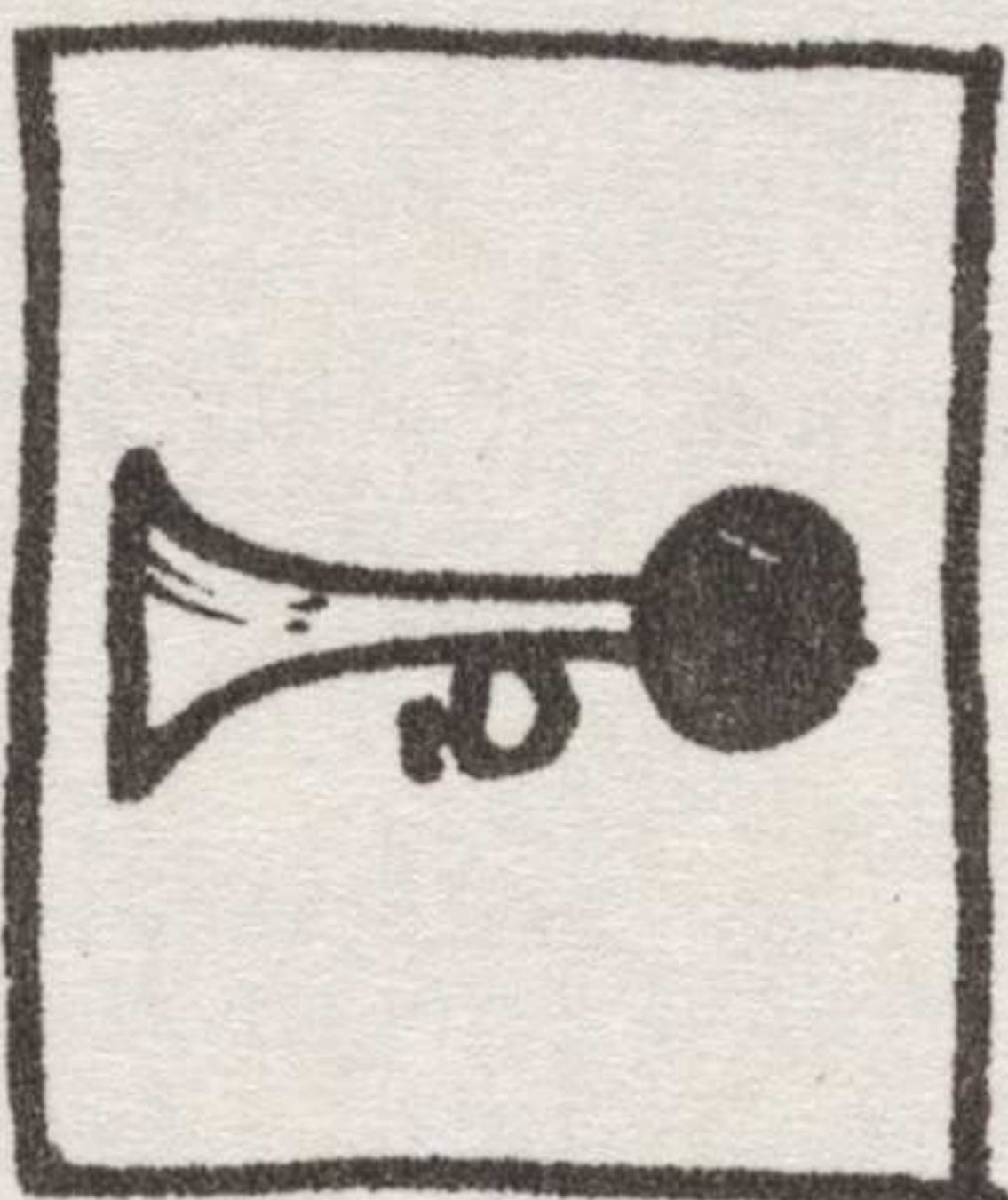
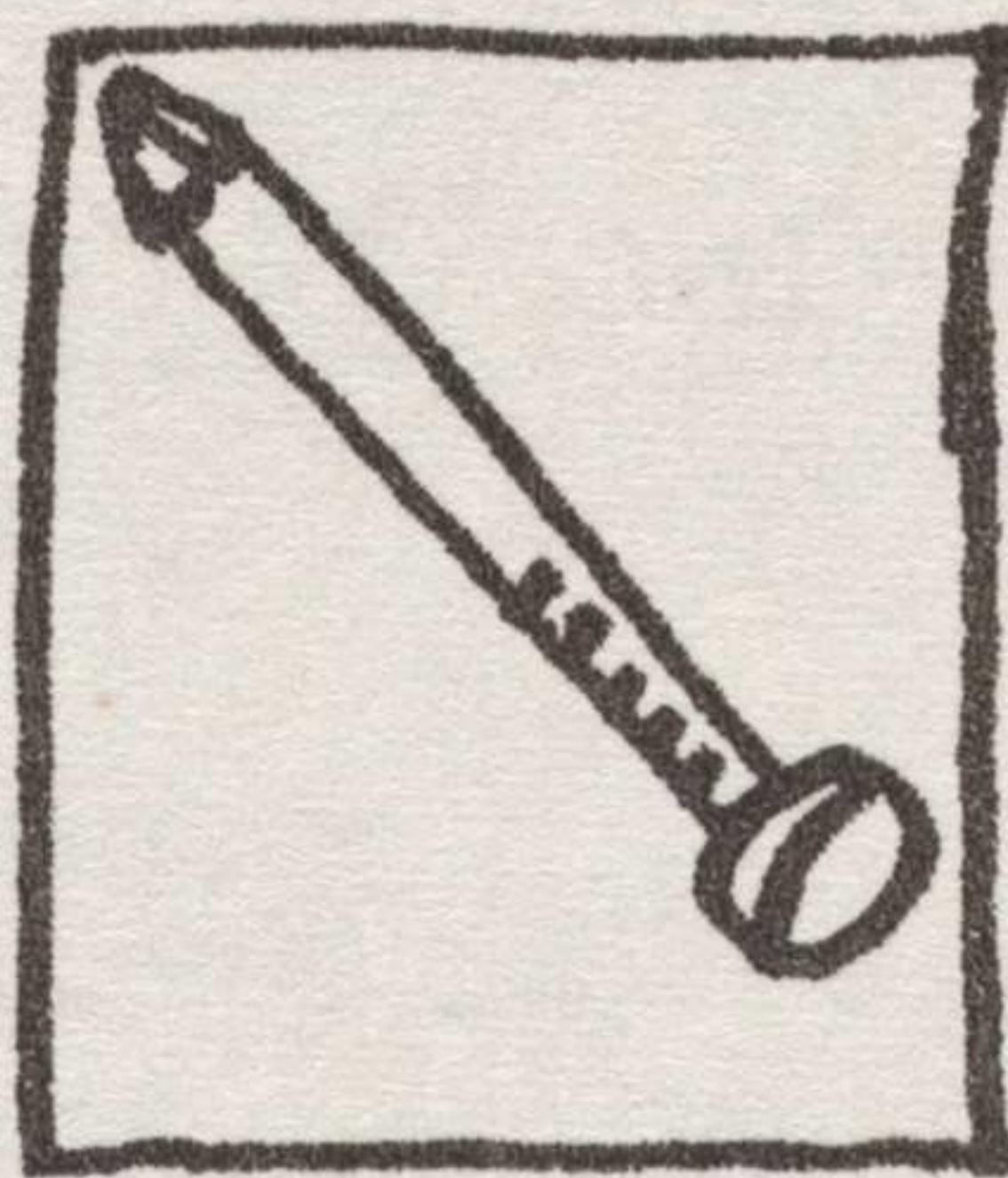
PRESENTATION

The teacher presents a set of cards to an individual or group and teaches the various meanings by means of a three period lesson.

LIST OF MULTIPLE MEANINGS (PARTIAL)

nail--fingernail, hardware nail
 cap--for head, for bottle, for gun
 horns--of animal, musical, car, shoe
 Hands--human, clock
 shoe--of man, of horse
 bill--of bird, dollar
 tracks--railroad, animal
 shade--window, lamp, tree
 pipe--to smoke, water, steam, gas
 ring- bell, for finger
 ear--of human, of corn
 legs--human, table
 shell--sea, egg
 hook--fish, clothes

Bulb--light, of plant
 box--container, to fight
 scale--to weigh on, of fish
 cone--ice cream, pine
 pitcher--pouring, baseball
 pump--gas, shoe
 comb--of chicken, for hair
 keys, for lock, of piano
 spout--rain, pouring
 bow--hair, ...and arrow, violin
 pin--safety, bowling, straight,
 hair, brooch
 glasses--drinking, eye, field (binoculars)



Multiple Meanings

ORAL LANGUAGEE. FOLLOWING ORAL DIRECTIONS

The ability to respond to oral language of increasing complexity is a necessary skill for the school age child. Only one example is given in the following sequence. How this and other sequences are developed will be discussed in class.

PURPOSE

To train children to listen
 To develop receptive vocabulary
 To develop response to complex sentence structures
 Later--to develop expressive language.

MATERIALS

Colored chairs, small box

PROCEDURE

1. Teaching the prepositions on and under.
 The children are gathered as a group. The teacher places a chair in front of them and shows them the small box in her hand. She puts the box on the chair, says "I put the box on the chair. Can you do that?" She chooses a child. "He put the box on the chair. Would anyone else like to try it?" She chooses another child. Repeats the procedure. Teacher then puts the box under the chair, says "I put the box under the chair. Can you do that?" She repeats the procedure as above, using the word under.

Teacher then demonstrates again, describing what she has done--
 "I put the box on the chair. I put the box under the chair."
 She then calls upon children to follow the directions of either putting the box on or under the chair. When children become proficient, she may ask them to express what they have done.
 "What did you do?" "I put the box (on-under) the chair."

2. Teaching the colors blue and yellow
 The teacher would follow a procedure similar to above, using only one preposition and two chairs of different color. ("Put the box on the blue chair." "Put the box on the yellow chair.")

3. The teacher would demonstrate, using two colors of chairs and two prepositions and would give similar directions.

"Put the box on the yellow chair."

"Put the box under the blue chair."

"Put the box under the yellow chair."

"Put the box on the blue chair."

4. Increasing complexities are introduced into the directions. They are first demonstrated by the teacher as in Example 1. Examples of increased complexity would be the following group. A chair of each color has been placed both near the door and near the window.

ORAL LANGUAGE

E. FOLLOWING ORAL DIRECTIONS (CONTINUED)

PROCEDURE (Cont.)

4. (Cont.)

Put the box on the yellow chair near the door.
Put the box on the yellow chair near the window.
Put the box under the yellow chair near the door.
Put the box under the yellow chair near the window.
Put the box on the blue chair near the door.
Put the box on the blue chair near the window.
Put the box under the blue chair near the door.
Put the box under the blue chair near the window.

ADDITIONAL

Sequential directions may be given--e.g.
Go to the table.
Go to the table and get the crayon.
Go to the table, get the crayon and put it in the box.
Go to the table, get the crayon, put it in the box, and put the box
on the shelf.
Go to the table, get the crayon, put it in the box, and put the box
on the bottom shelf next to the metal insets.

...and so forth.

F. LANGUAGE PATTERNING

PURPOSE

Acquiring control of basic grammatical structures.
Familiarizing the child the forms of standard English.
Development of receptive and expressive language.

PROCEDURE

A sequence of lessons is available in the following source:
Miami Linguistic Readers Series--Teachers Manual, Level 1
D. C. Heath & Co.
475 So. Dean Street
Englewood, New Jersey, 07631

These lessons will be studied and discussed in class. Copies of the book will be distributed.

ORAL LANGUAGE

G. FURTHER DEVELOPMENT OF EXPRESSIVE LANGUAGE

PURPOSE

Stimulation of conversational language on the part of the child--
Use of extended vocabulary, grammatical structures, etc.
Practice in standard English.

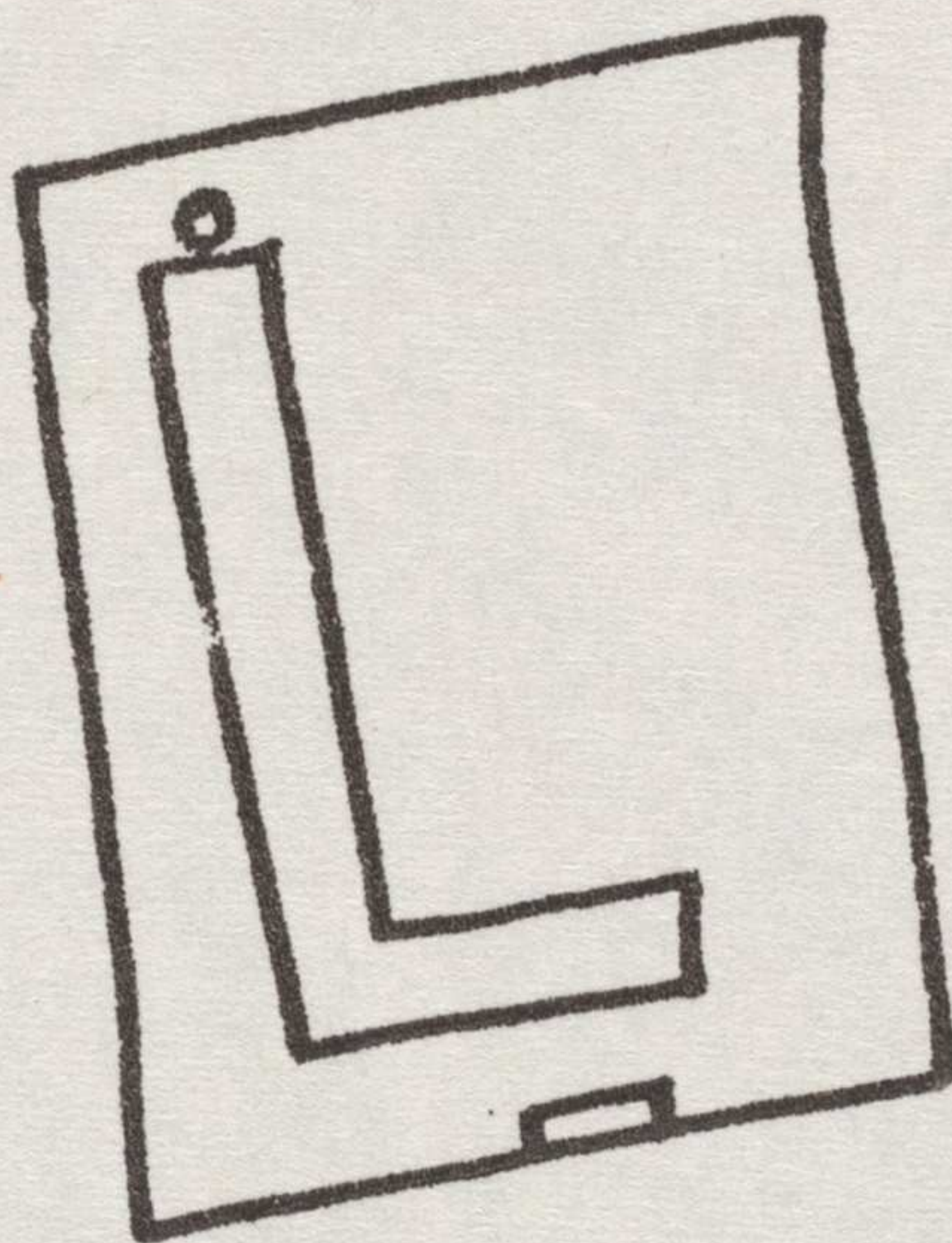
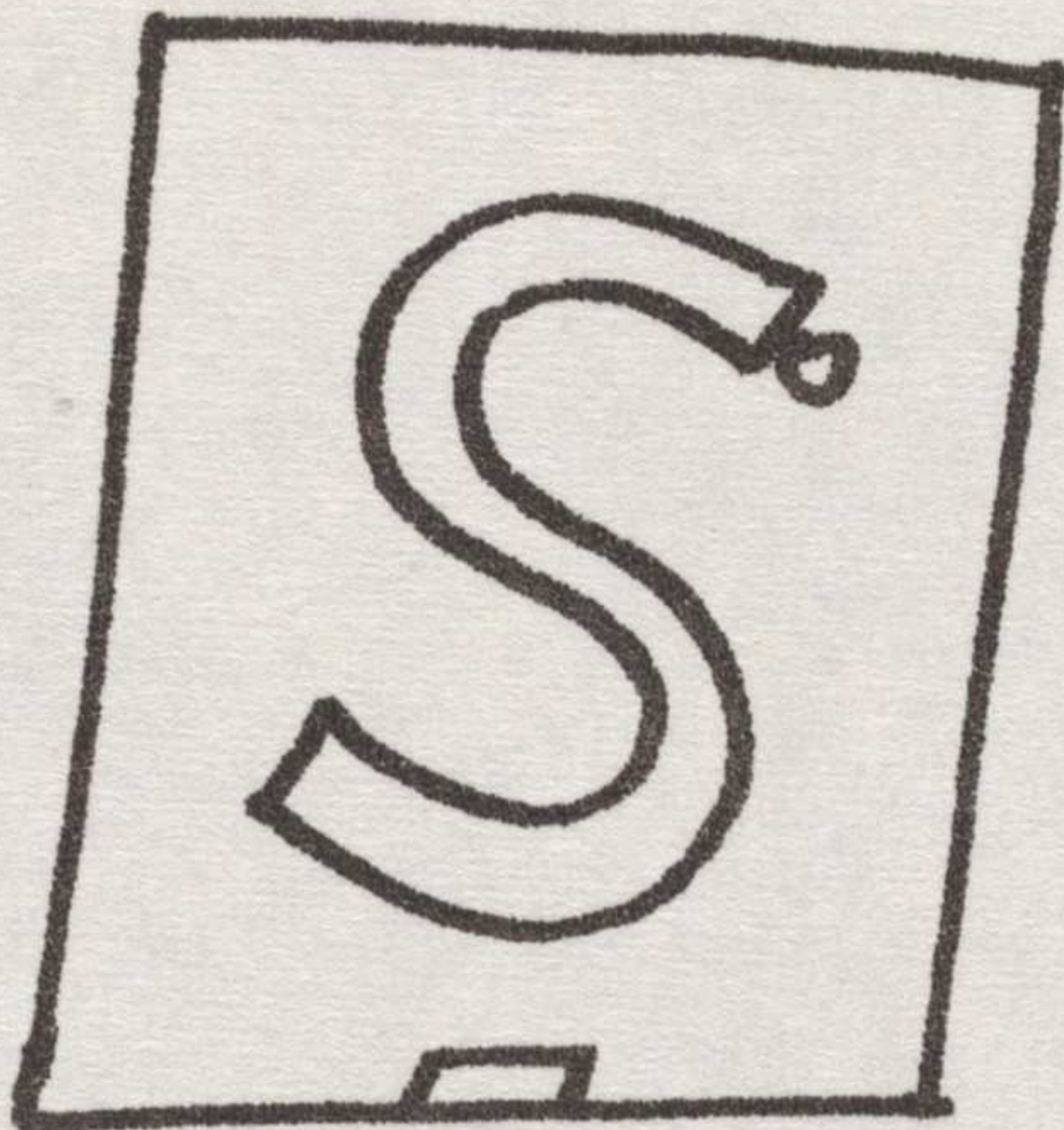
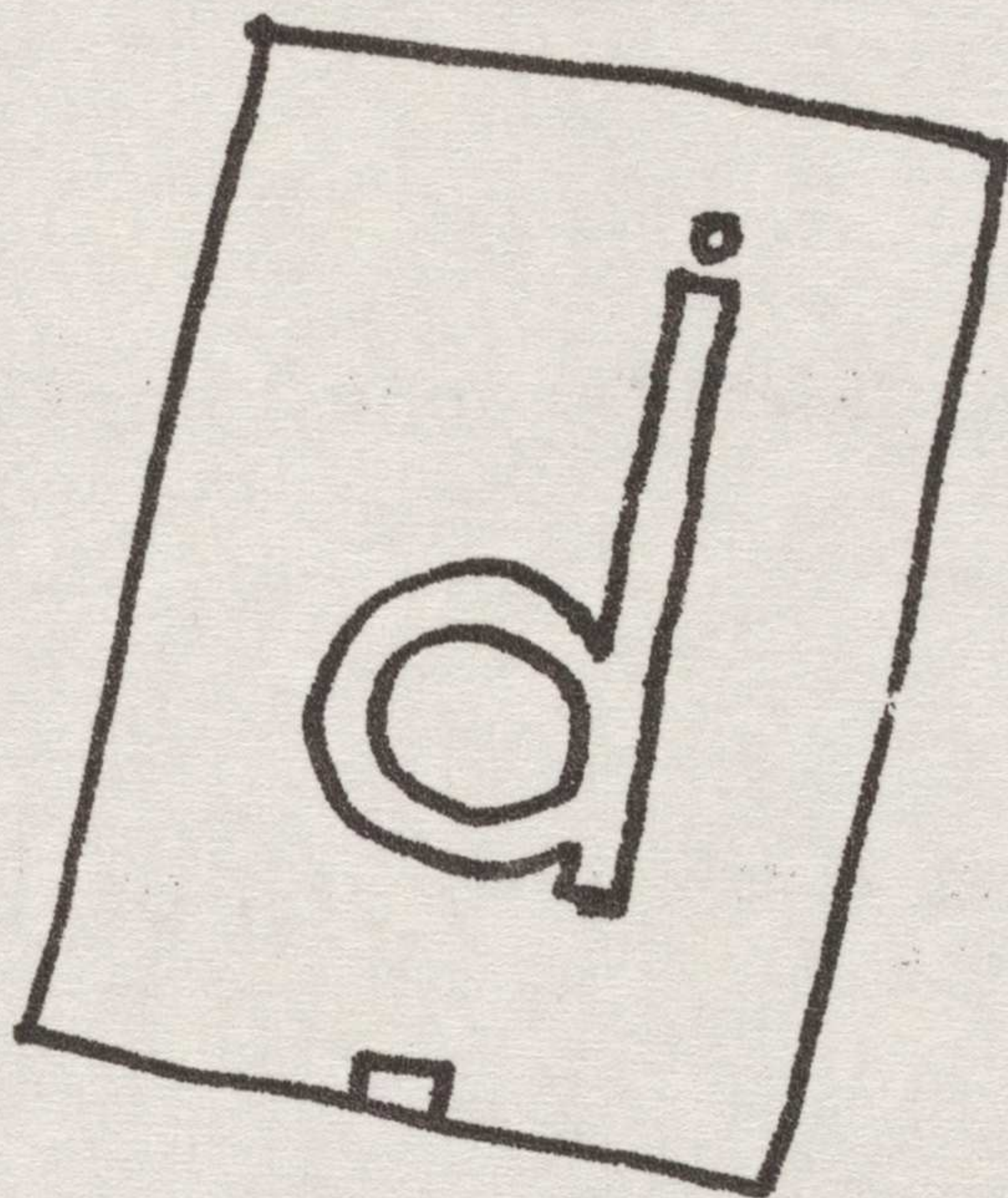
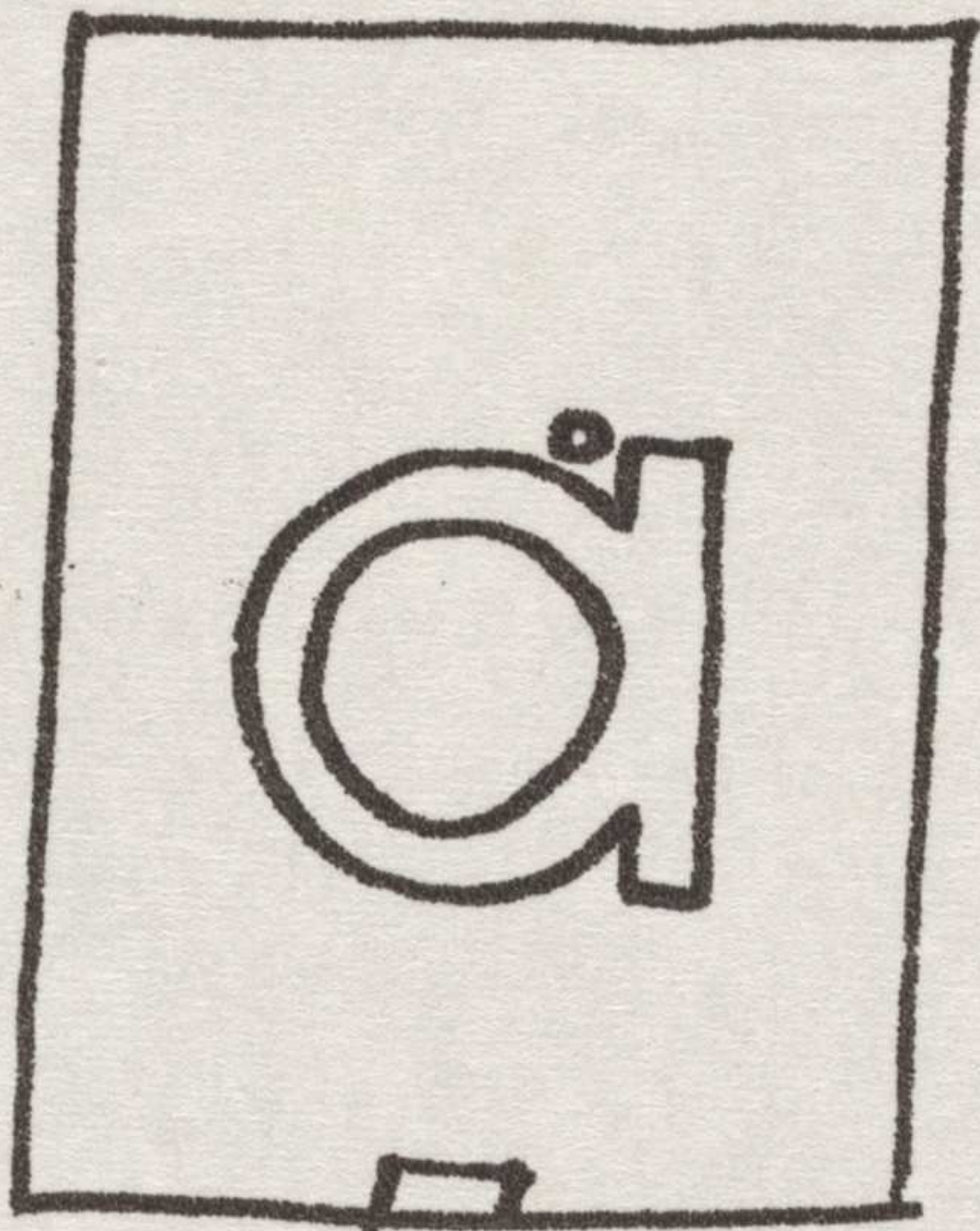
MATERIALS

Toy telephones, photographs, books, Show and Tell, Experience
Charts, etc.

PROCEDURE

Discussions and demonstration of the above materials will be
covered in class.

Sandpaper Letters



II. PREPARATION FOR READING

A. ALPHABET MASTERY - SANDPAPER LETTERS

MATERIAL:

1. Sandpaper letters cut from light grain sandpaper which are mounted on a wood or masonite backing.
2. The consonants are mounted on red cards, the vowels on blue cards.

PURPOSE:

1. Introduce the child to the name or sound which corresponds to the written symbol.
2. Provide an experience to integrate muscular movement (by tracing the letter), with the auditory signal provided by the teacher.
3. Preparation for writing; - practice in proper directional sequence.

AGE:

3-1/2 and up.

CONTROL OF ERROR:

1. Tactually-The sandpaper. If the child's fingers slip away from the surface, the child will notice the difference in texture.
2. Auditory-The speech model which the teacher presents to the child.

PRESENTATION:

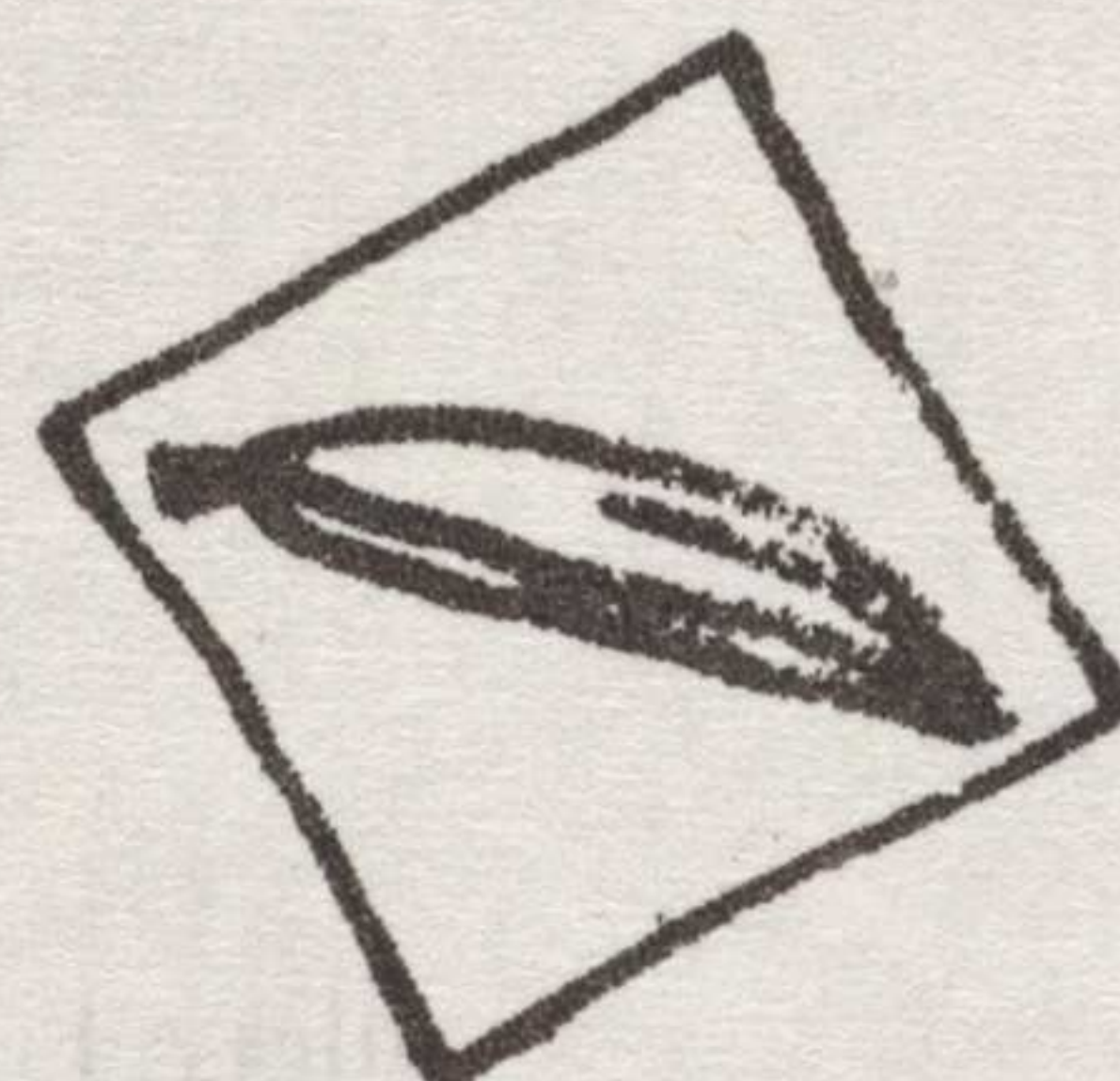
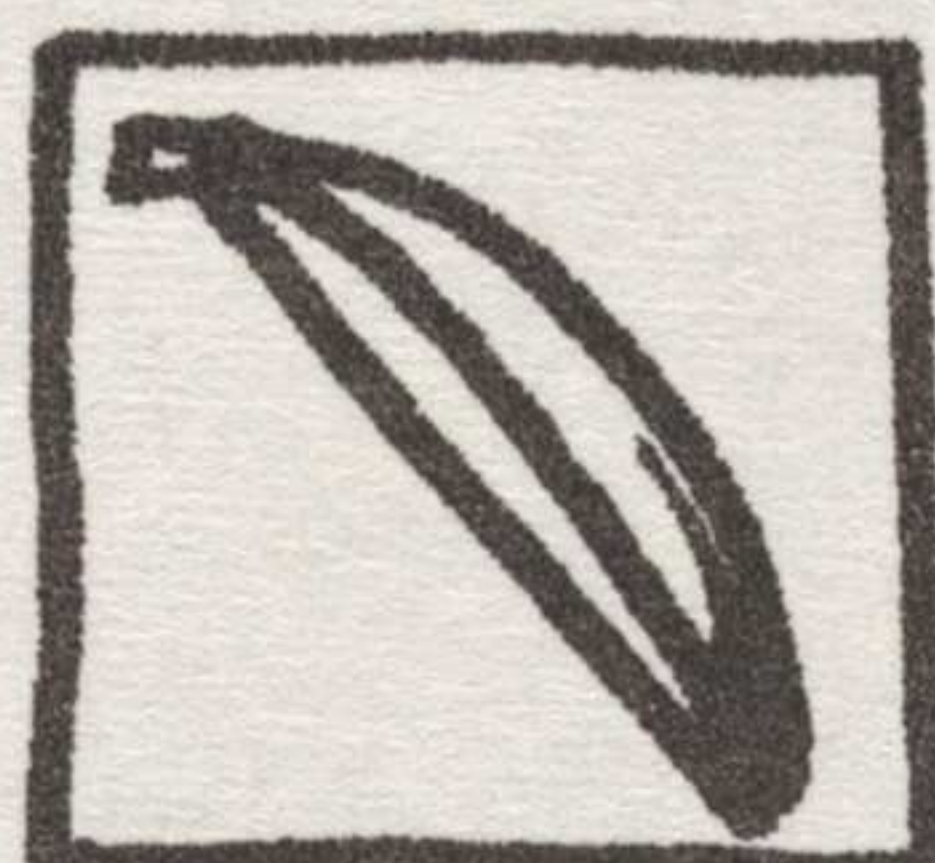
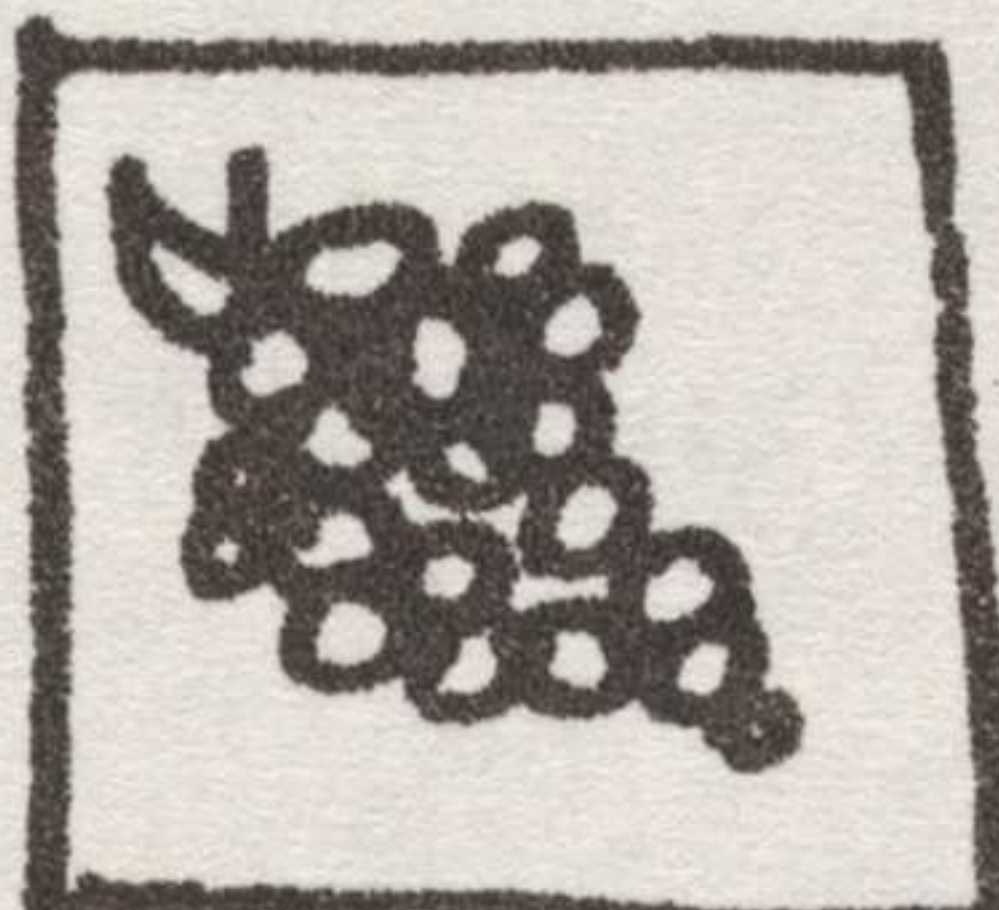
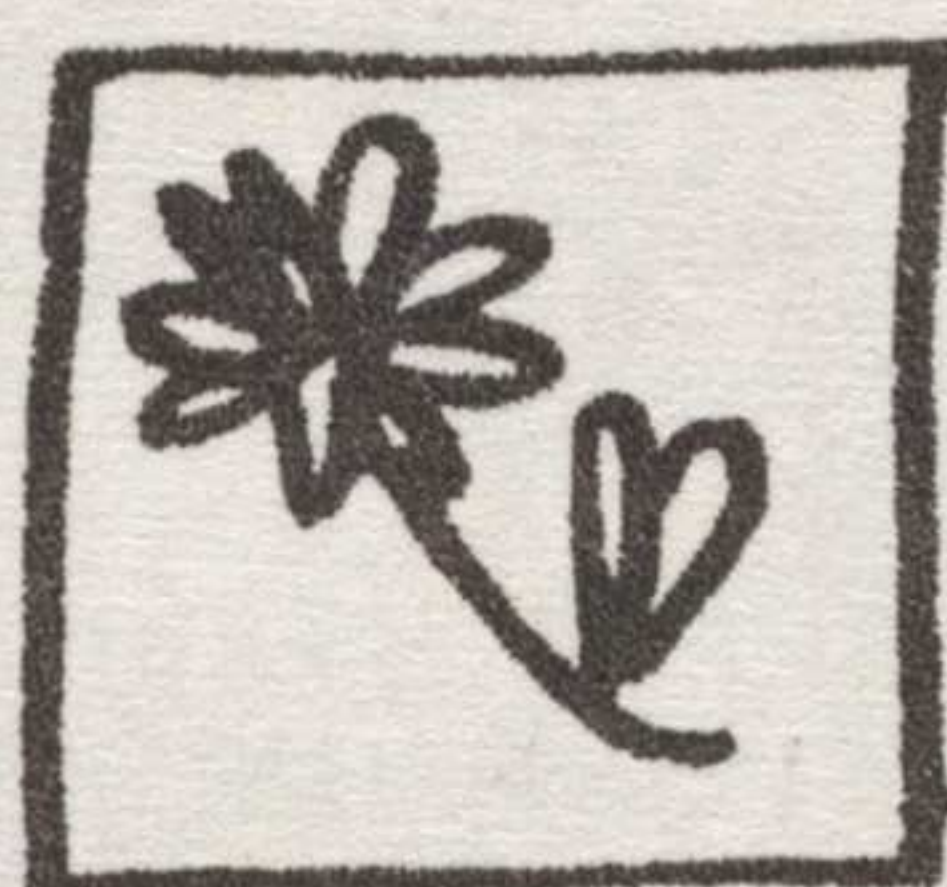
1. Choose two or three letters which the child is capable of verbally producing.
2. With the child seated at a table, place the sub-dominant hand on the corner of the board. Trace the form of the letter using the first and second fingers of the dominant hand.
3. As the letter is traced, produce the sound or name.
4. Invite the child to trace the letter. See that he used the dominant hand. Ask the child to produce the name or sound corresponding to the symbol.
5. When the child has named the name or sound repeat it after him.
6. Repeat this process with each symbol.
7. A three period lesson may be conducted with a few letters which have been previously presented to the child. Ask him to show you a given letter by saying:

"Show me ----"

"What is this"

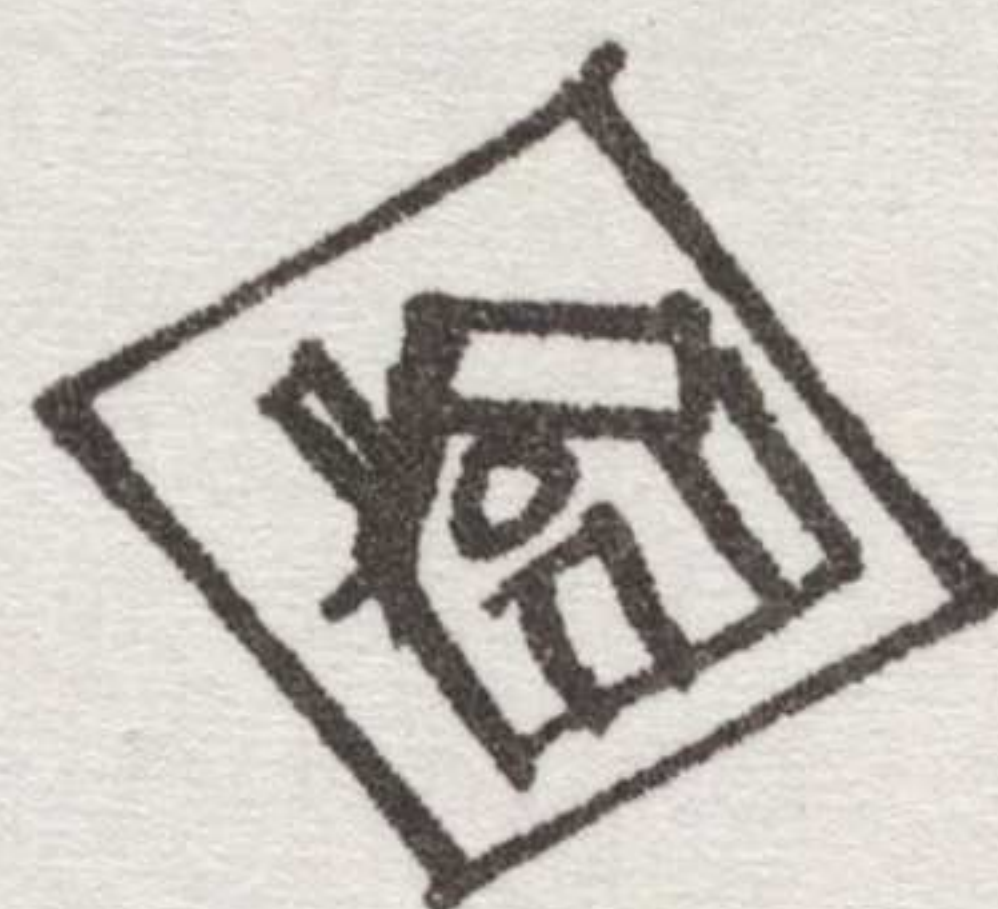
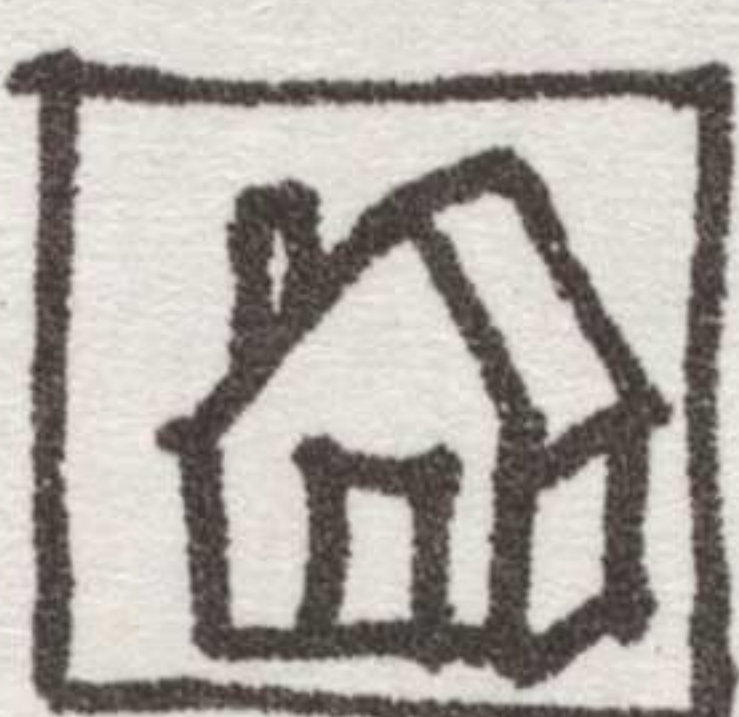
Have the child trace the letters as he produces the sounds.

I



Picture
Matching

II



PREPARATION FOR READING

B. MATCHING EXERCISES

I. PICTURE MATCHING

PURPOSE

Training in visual discrimination
Recognition of distinct shape that identifies individual letters

MATERIALS

Sets of materials in duplicate--from simple matches to more complex ones where difference between pairs in a set is very slight; table or floor mat.

PRESENTATION

Teacher lays one set of cards out in a vertical row. Cards of an identical set are then mixed and matched to form pairs.

2. MATCHING LETTER CLUSTERS

PURPOSE

Further training in visual discrimination
Recognition of the distinct shape that identifies individual letters.

MATERIALS

Workbook pages, plastic envelope, grease pencil, small cloth

PRESENTATION

Teacher inserts a work sheet in the envelope, demonstrates circling or underlining correct items. She erases plastic, child repeats.

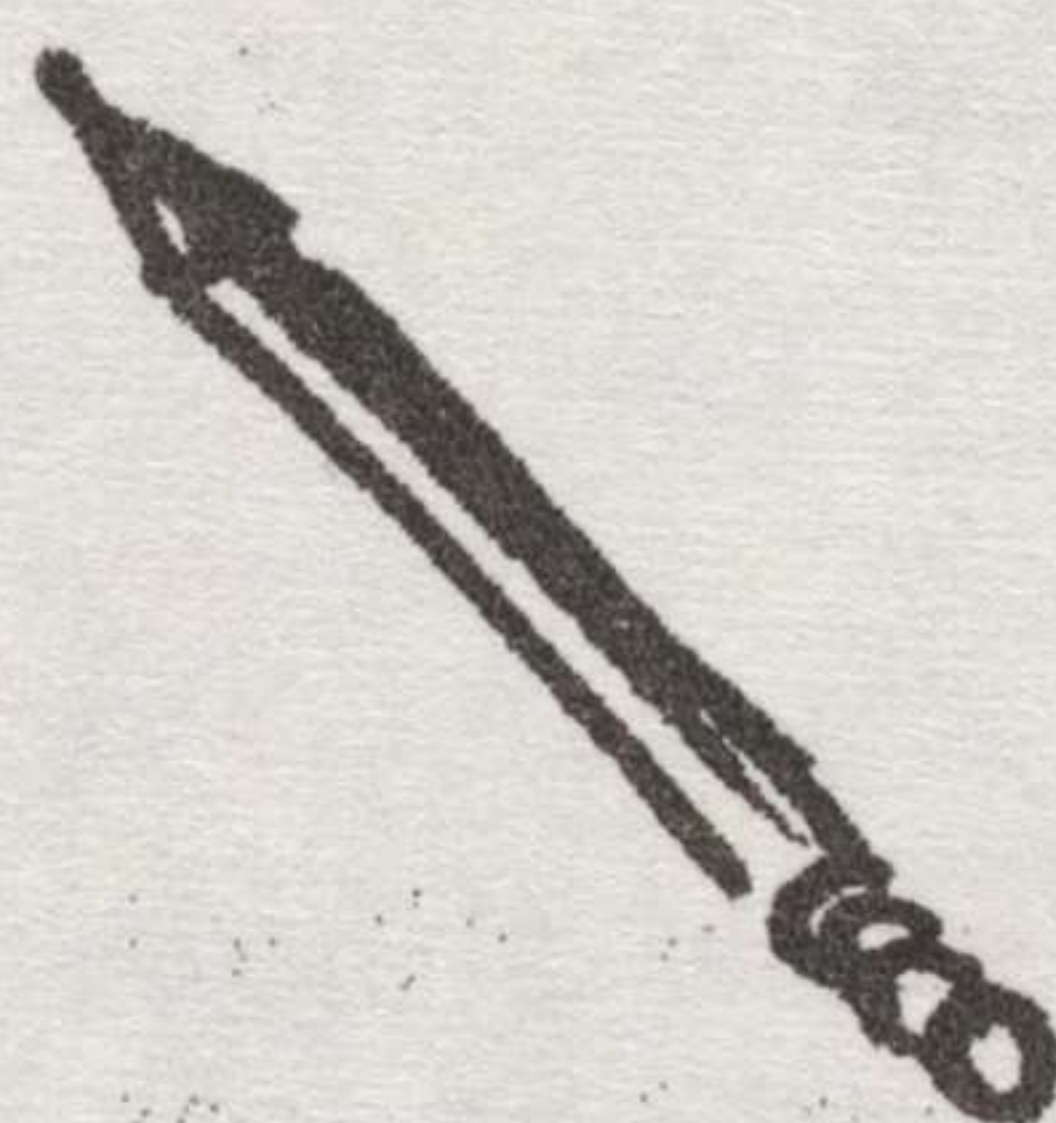
Control of error--master sheet with correct items indicated.

ad	ao	ad
eo	eo	ea
rh	rm	rn

Letter
Clusters

ea	oa ae ea an ne
ad	ae ad de do ad
ah	
ho	

ed	oe
eo	do
ao	ea
oe	eo



PREPARATION FOR READINGC. RHYMINGPURPOSE

To develop recognition of rhyme
 To develop skill in rhyming
 Indirect preparation for later work with word patterns

MATERIALS

1. A box of small objects that rhyme -place mat to define table area
2. The above, plus a partitioned box or tray into which pairs of rhyming objects can be placed.
3. & 4. Pictures of objects that rhyme; slotted card holder or table mat.
5. Work cards or sheets with 9-12 pictures arranged in horizontal groups of three. Two of these three pictures would rhyme. At least 5 different such sheets could be used to allow for repetition.

PROCEDURE

1. Exploration of materials.

Materials and place mat are on shelf. Teacher explains to the group that she is going to show them something, goes to the shelf and gets articles. Teacher presents the box of objects to the children. She tells them the name of each object so that they learn the appropriate vocabulary (e.g. If "wire" is to rhyme with "tire", children should not call the latter a "sheel"). Teacher keeps objects on the mat. Teacher asks children to identify the objects she names. She asks children to name the objects. She closes the box, returns it and mat to the shelf and, if they are interested, chooses a child who can take the materials to a table to examine and play with, keeping them on the mat.

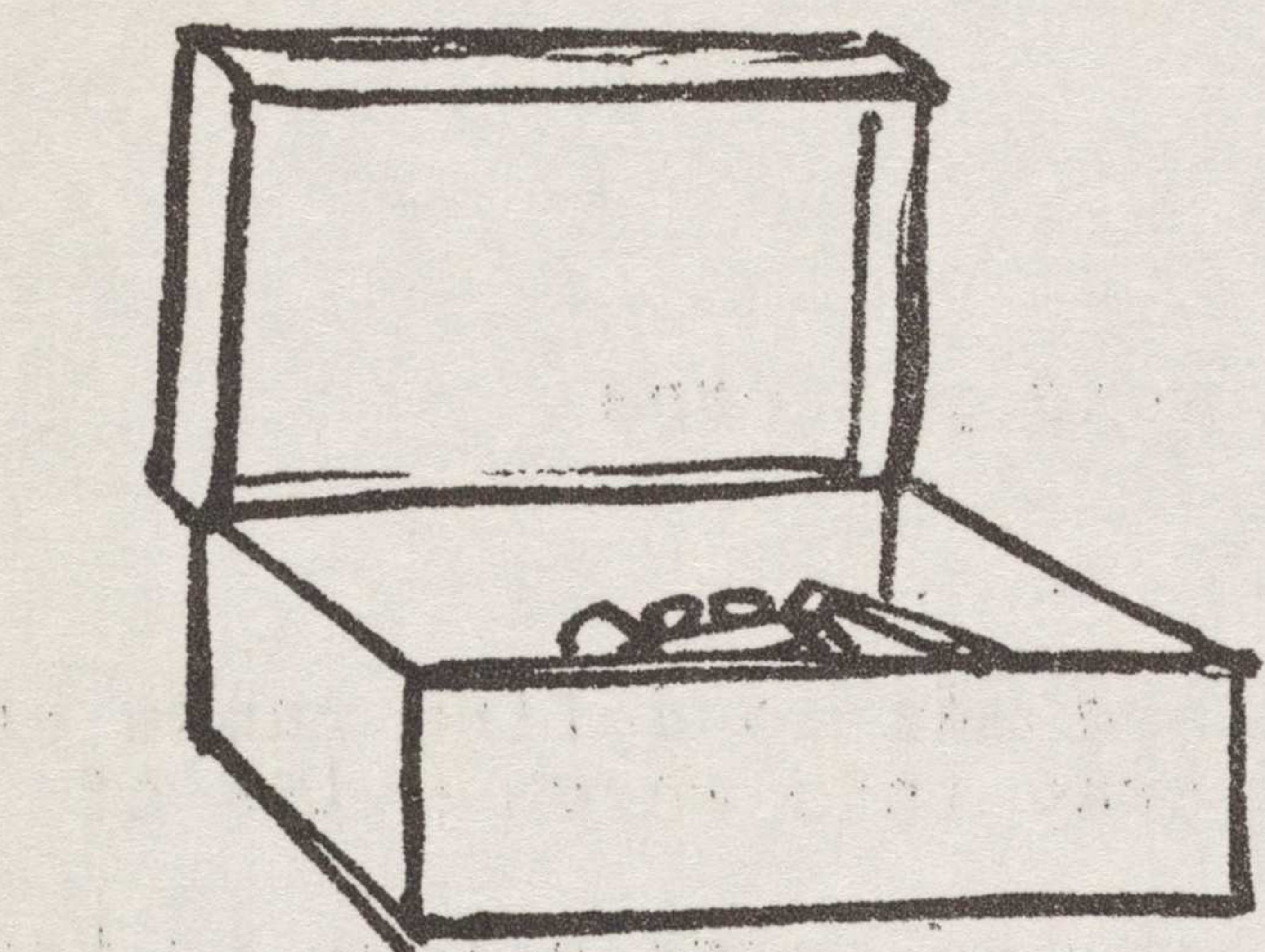
2. Pairing the rhyming objects

Teacher again explains to the group or individual that she is going to show them something new, goes to shelf and gets materials. Reviews stage 1 (above). Then she carefully pairs rhyming objects, placing each pair in a separate space in partitioned box. When finished, the teacher replaces objects in the box and asks who would like to try it. A child is chosen and is helped, if necessary. Additional children are chosen. Materials are returned to the shelf and children are told they may use the game one at a time whenever it is not being used. If a visual control of error is desired, the pair of objects may be pictured on the bottom of the object box and when it is emptied, child can check his combinations.

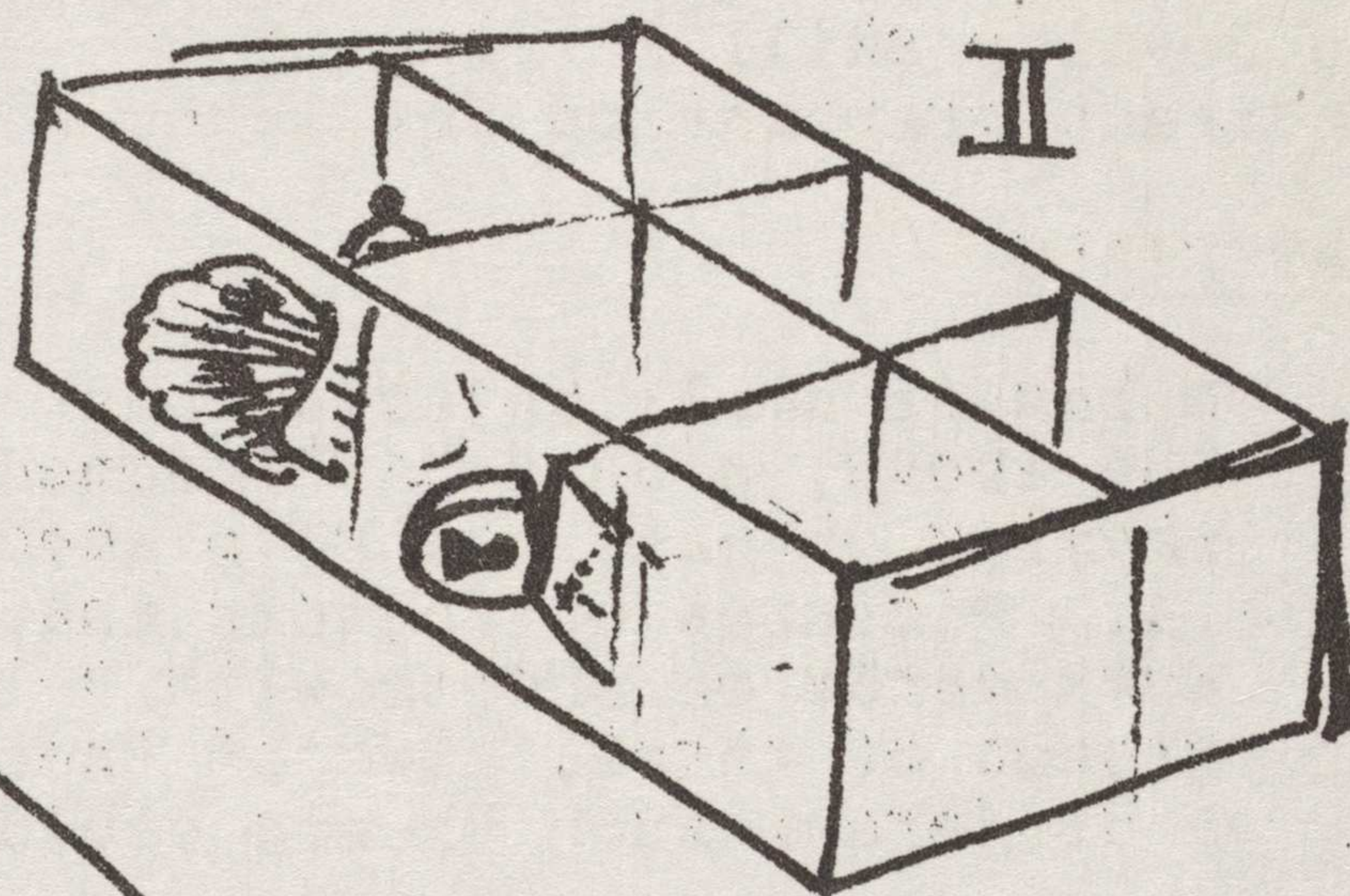
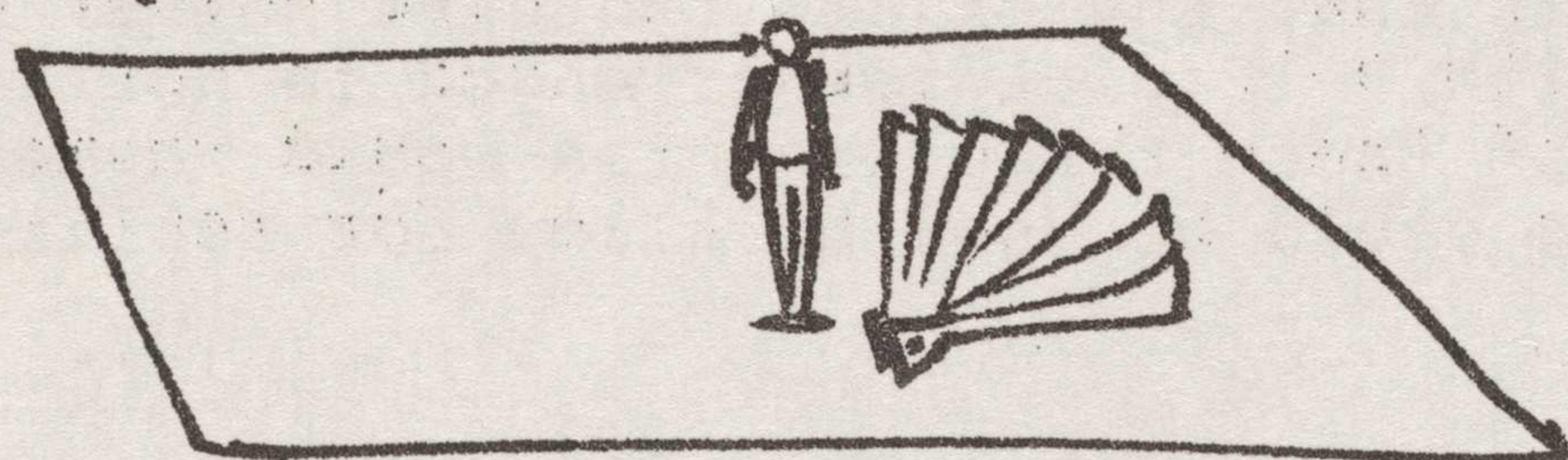
3. Pairing of rhyming pictures

Teacher presents rhyming combinations of picture cards, placing them in card slots or on table mat. Cards are then placed on table in random order and children are called on to match one placed in slot or on mat by teacher.

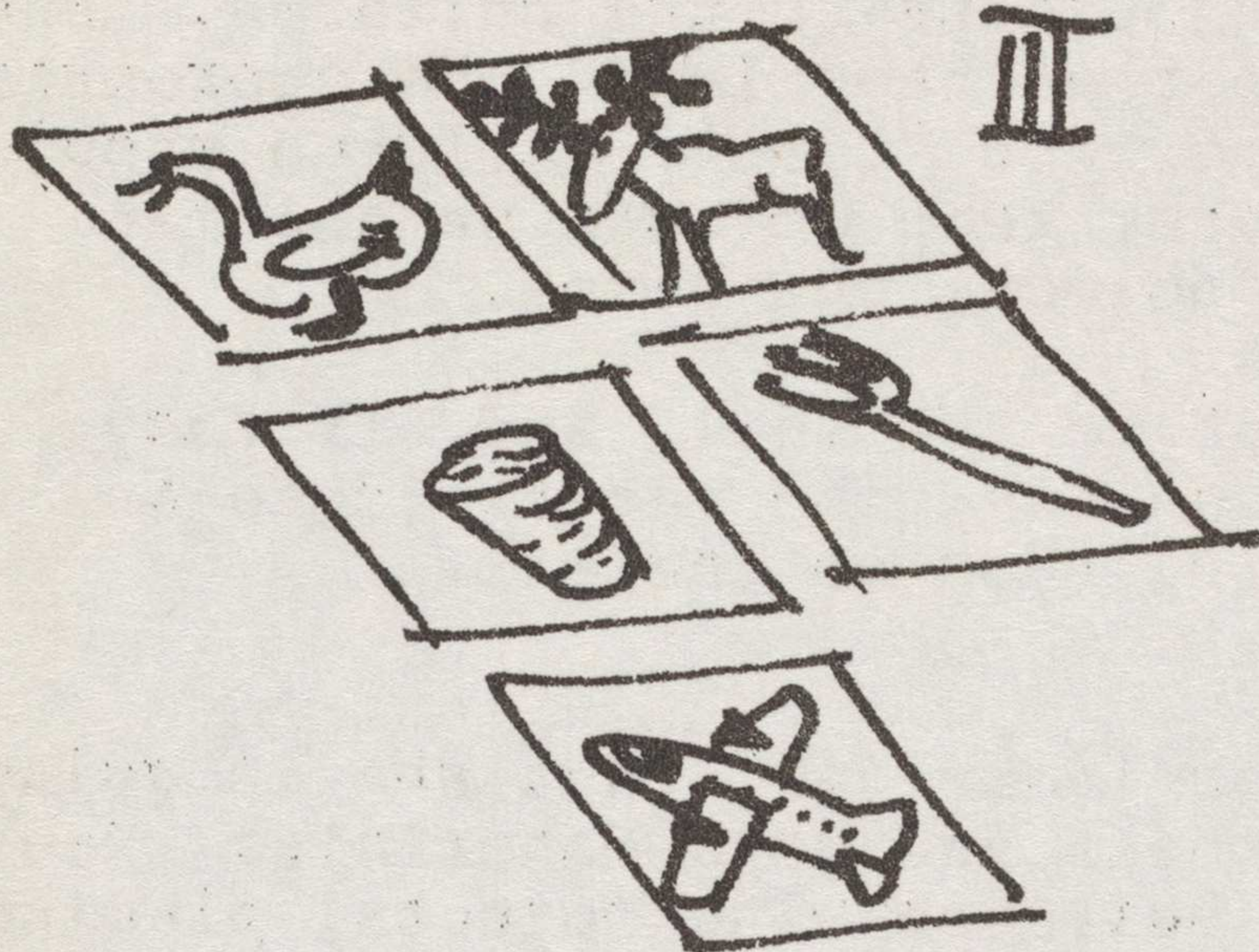
Rhyming



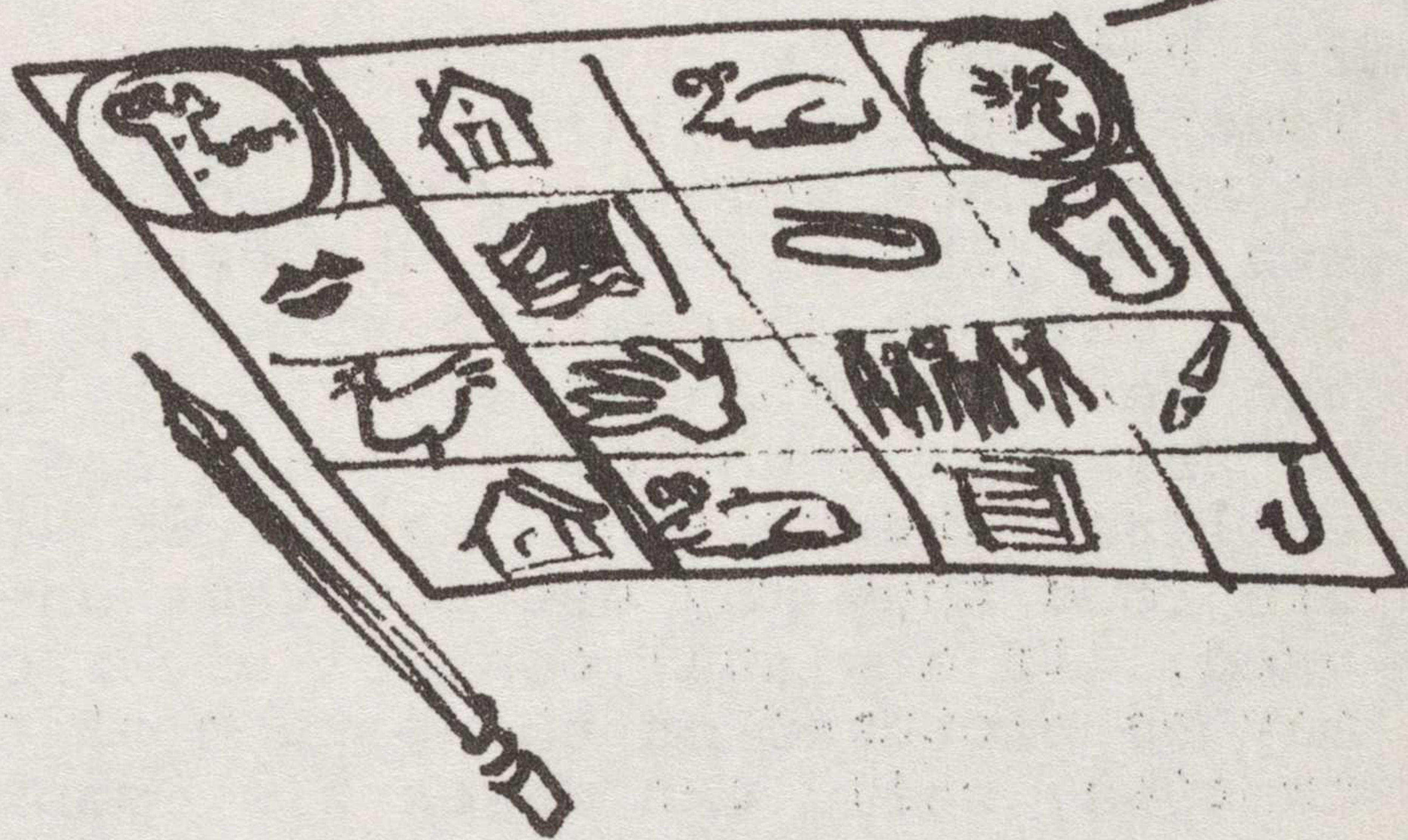
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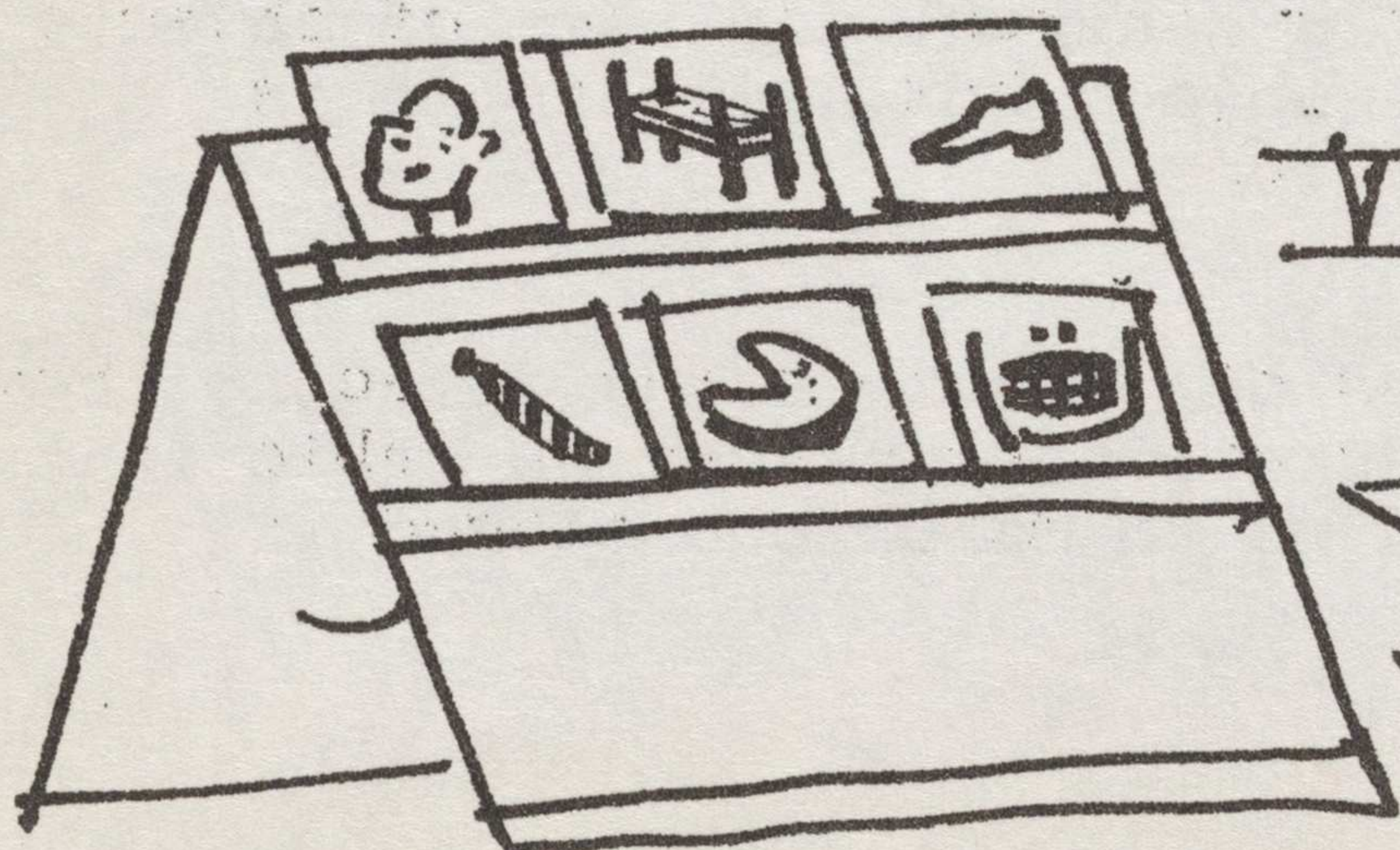
II



III



IV



V

PREPARATION FOR READINGRHYMING (CONTINUED)

4. Teacher places three pictures across horizontally. She identifies the two out of the three that rhyme. She does this several times with different sets of three, then calls upon child to identify two out of three that rhyme.

5. A supply of mimeographed work sheets is on hand where child can practice identifying rhyming words by circling pictures. A wall chart could indicate correct combinations so child could check his answers.

ADDITIONAL

Other rhyming games can be played by the teacher with a group -- e.g., teacher could call out a word and children could volunteer words that rhyme with it.

Nursery rhymes, poetry and rhyming stories should be read to the children.

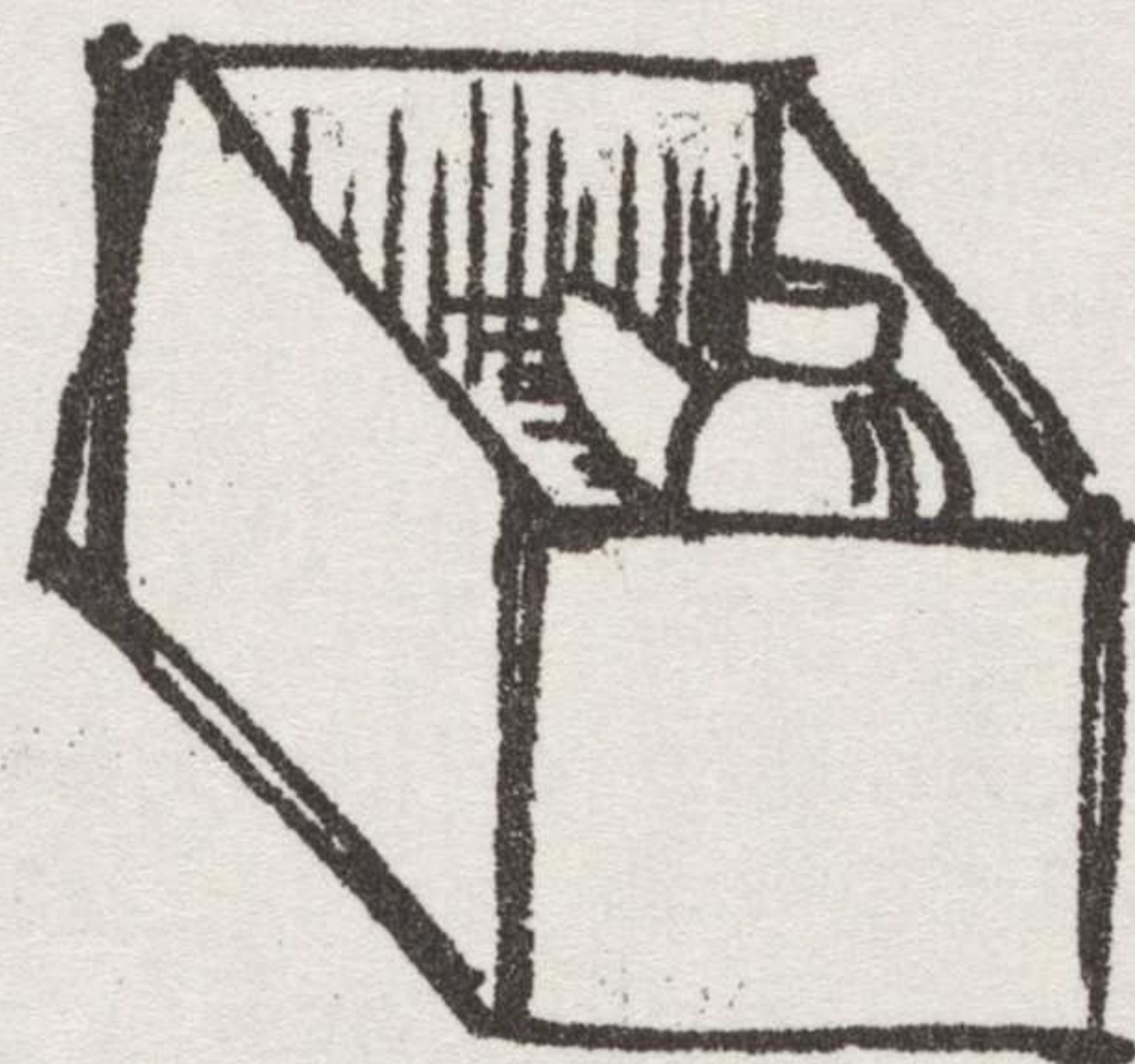
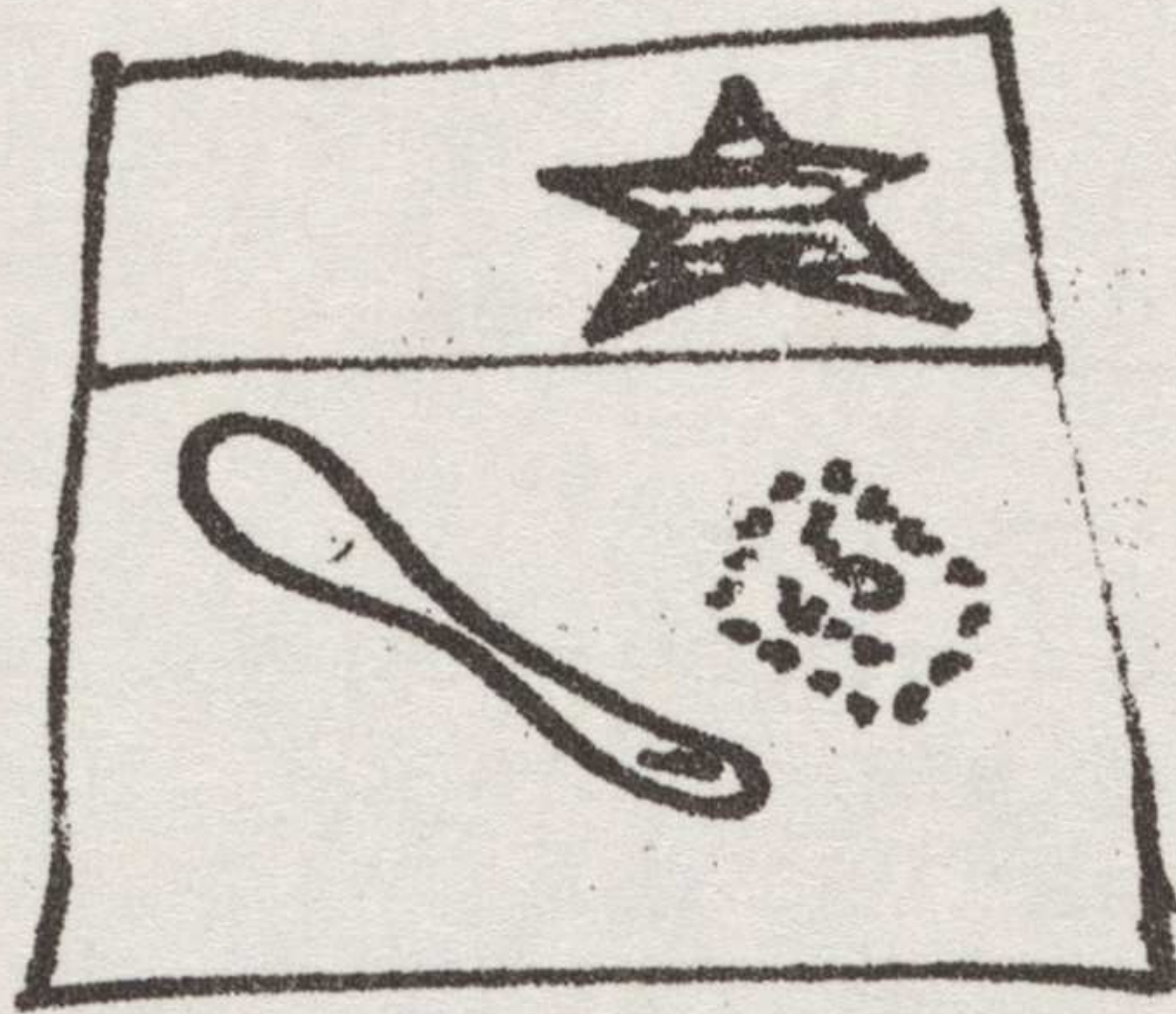
Suggestions for Rhyming Objects or Pictures

house-mouse	goat-coat-boat	cat-hat
bell-shell	book-hook	dog-frog-log
sock-lock-block-rock	cork-fork	plane-cane
car-star	moon-spoon	nail-pail
pear-bear	wire-tire	ink-sink
bug-jug	flag-bag-rag	man-pan-can-fan
duck-truck	moose-goose	rake-snake
fox-box	dot-pot	
chair-hair	yarn-bard	

STORY BOOKS IN RHYME

ABC BUNNY--Wanda Gag
 MADELINE--Bemelmans
 SILLY BILLY'S ALPHABET--Ruth E. Libbey
 GOOD NIGHT MR. BEETLE--LELAND B. JACOBS
 MILLIONS AND MILLIONS--Slobodkin
 BEARS--Kraus
 GOOD DAY--WHICH WAY?
 IF APPLES HAD TEETH--Glaser
 HOW WOULD YOU ACT--R. & S. Brod
 YOU KNOW WHO--John Ciardi
 THEN WHICH DID YOU DO?--R. Park
 KAREN'S OPPOSITIES--Provinsen
 SOME CHEESE FOR CHARLES--Buckley
 THE COMPLETE NONSENSE BOOK--Lear
 FROG WENT A'COURTING--Langstaff
 OVER IN THE MEADOW--Langstaff
 GOODNIGHT MOON--Margaret Wire Brown

Initial Consonant Sounds



PREPARATION FOR READING - AUDITORY

D. LISTENING TO INITIAL CONSONANT SOUNDS

PURPOSE

Training in auditory discrimination
Development of ability to discriminate between consonant sounds
Preparation for later reading

MATERIALS

1. Boxes of objects representing initial consonant sounds, cardboard mats divided in half with a key picture on each half to indicate the initial consonant sound.
2. Sets of pictures that begin with the individual consonant sounds
3. Mimeographed work sheets with the key picture circled and a group of additional pictures, some of which begin with the same sound as the key.

PRESENTATION

1. Teacher selects two sets of objects and mixes them in a box. She places the accompanying key card on the table. She takes the objects one by one from the box, says, the word, repeats the key words and finally places the object under the picture that begins with the same sound as the object.
"These begin with the same sound."
The teacher places all the objects, then repeats the words and key word to indicate similarity of initial sounds. She then replaces objects in the box and the child has his turn. Control of error-- pictures on back of key card.
2. Pictures are classified according to initial sound in a similar way.
3. Children choose a work sheet and circle pictures that begin with the same sound as the circled key picture.

CONTROL OF ERROR

Master sheet which indicates correct choices.

PREPARATION FOR READING--Sound-Symbol CorrespondenceE. NAMING INITIAL CONSONANT SOUNDSPURPOSE

To make the relationship between sound and symbol
 Further practice in classifying initial consonant sounds
 Preparation for reading.

MATERIALS

1. Boxes of objects representing initial consonant sounds, cardboard mats with key pictures on each half, 2 consonant cards with respective consonants printed on each
2. Sets of pictures that begin with individual consonant sounds, consonant cards
3. Mimeographed work sheets with gummed labels with the individual consonants printed on them.

PRESENTATION

All the presentations are the same as
 D. Listening to Initial Consonant Sounds, with the following additions:

1. Labels are placed on the top of both halves of the cardboard mat so that the category is represented by symbol as well as by picture.
2. The same procedure is followed in using the pictures
3. Teacher does a work sheet as described in preceding exercise. This time, however, she names the consonant sound, finds an appropriate label and glues it to the sheet.
 "These words begin with ____ (name or sound of letter)".

PREPARATION FOR READING

F. SUGGESTIONS FOR OBJECTS USED IN EXERCISES D AND E
(PREPARATION FOR READING)

A
apple, alligator, acrobat, ambulance, aspirin, antelope, ant,
animals, animal crackers, astronaut, apricot, almond, ash tray

E
elephant, eskimo, egg, egg cup, eraser, electric cord, emery
board, engine, airplane, aircraft carrier, empty box, elf,
eggbeater, envelope

I
ink, indian, igloo, isthmus, index cards, insignia, insect

O
octopus, ostrich, orange, olive, octagon

U
umbrella, underwear

B
banana, brush, bow, bottle, bathtub, badge, ball, bug, baby,
basin, bracelet, bird, bear, buffalo, bed, boat, bank, bat
butterfly, boy, bee, beads, basket, bugle

C
couch, crayon, cat, candy, cup, cupboard, cowboy, camel, cookie,
cow, clown, key, candle

D
dish, diesel, drill, doll, deer, dresser, dress, duck, donkey, dog,
drum, dot

F
fish, frog, fox, flag, fork, feather, file, flower, fireplace,
fire engine, fireman, fur

G
grapes, gun, garage, goat, glass, gorilla, globe, goose, girl, glove
glue

H
horse, hammer, hat, handkerchief, hamper, hanger, house, heart, hand-
cuffs, horn, hen

J
jet, jack, jello, jar, jam, jelly, jewel, jewelry, jeep, jaguar,
jack-in-the-box, jack-o-lantern, jacket

K
kite, kangaroo, key, kitten

OBJECTS FOR OBJECT BOXES (CONTINUED)L

lemon, locket, lobster, lollipop, lizard, lion, locomotive, lace, lock, leopard, lid, light bulb, lamb, leaf, lily, ladder, lipstick

M

money, man, mirror, marble, magnet, monkey, moose, moon, mouse, mitten

N

nut, nutcracker, knob, necklace, nail, nun, knife, needle, nickel, noodles, knight, napkin

P

pineapple, pear, plum, piano, pencil, pliers, place, pin, pan, pen, pig, penguin, pistol

Q

queen, quilt, quill, quail

R

rose, ring, rubber band, wrench, rocket, rhinoceros, rabbit, reindeer, rake, rooster, rattle, rock, rifle, refrigerator

S

sink, skunk, snake, soldier, spoon, stick, sign, spider, spool, submarine, sunglasses, stove, screwdriver, skeleton, scissors, squirrel

T

table, toilet, tray, turtle, television, teapot, tugboat, turkey, telephone, top, tiger, train

V

violet, vase, veil, vacuum cleaner, vest, Viking, Volkswagen, violin, valentine, velvet, vegetables

W

whale, walnut, wheel, whistle, watch, watering can, wolf, witch, worm, wagon, wheelbarrow

XY

yarn, yo-yo, yacht, yak, yellow

Z

zipper, zebra, zoo

Sh

shoe, shoelace, shark, shampoo, shirt, shell, sharpener, shovel, ship, sheep, shrimp, shower cap

Ch

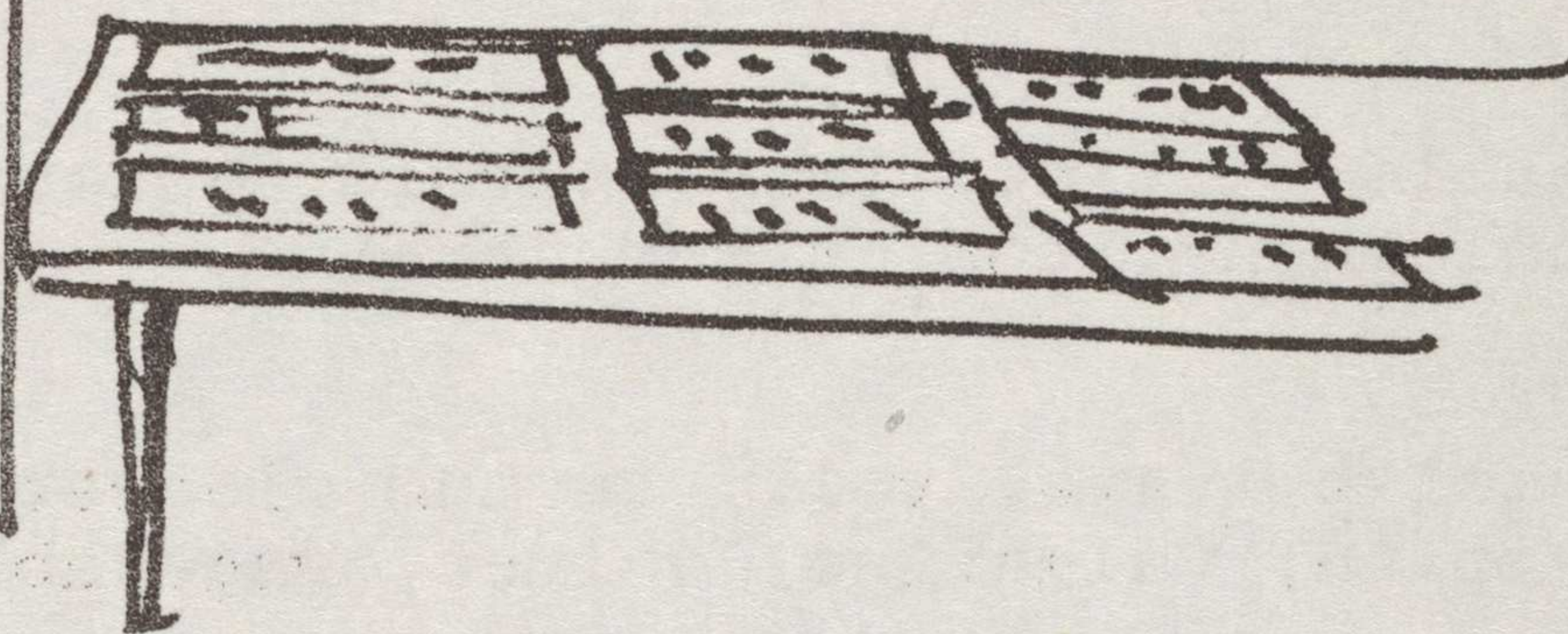
chewing gum, chiklets, chair, chain, cherries, chest, chest of drawers, cheese, children, child, chicken, chocolate, chalk

Th

three, thread, thimble, thermometer

Name Recognition

	Susan		
	Billy		
	Anne		Ted
			
			Nancy
			John
			
			



PREPARATION FOR READING

G. NAME RECOGNITION

PURPOSE

Beginnings of reading--child recognizes his own name and those of other children.

MATERIALS

Oak tag strips on which children's names are clearly printed
Card holder

PROCEDURE

Before the children enter the room, the teacher lays the name cards on a table. As children enter, they place their name in the card holder. In the beginning, the teacher can make it less difficult by placing the cards in groups of two or three and telling the child in which group to look.

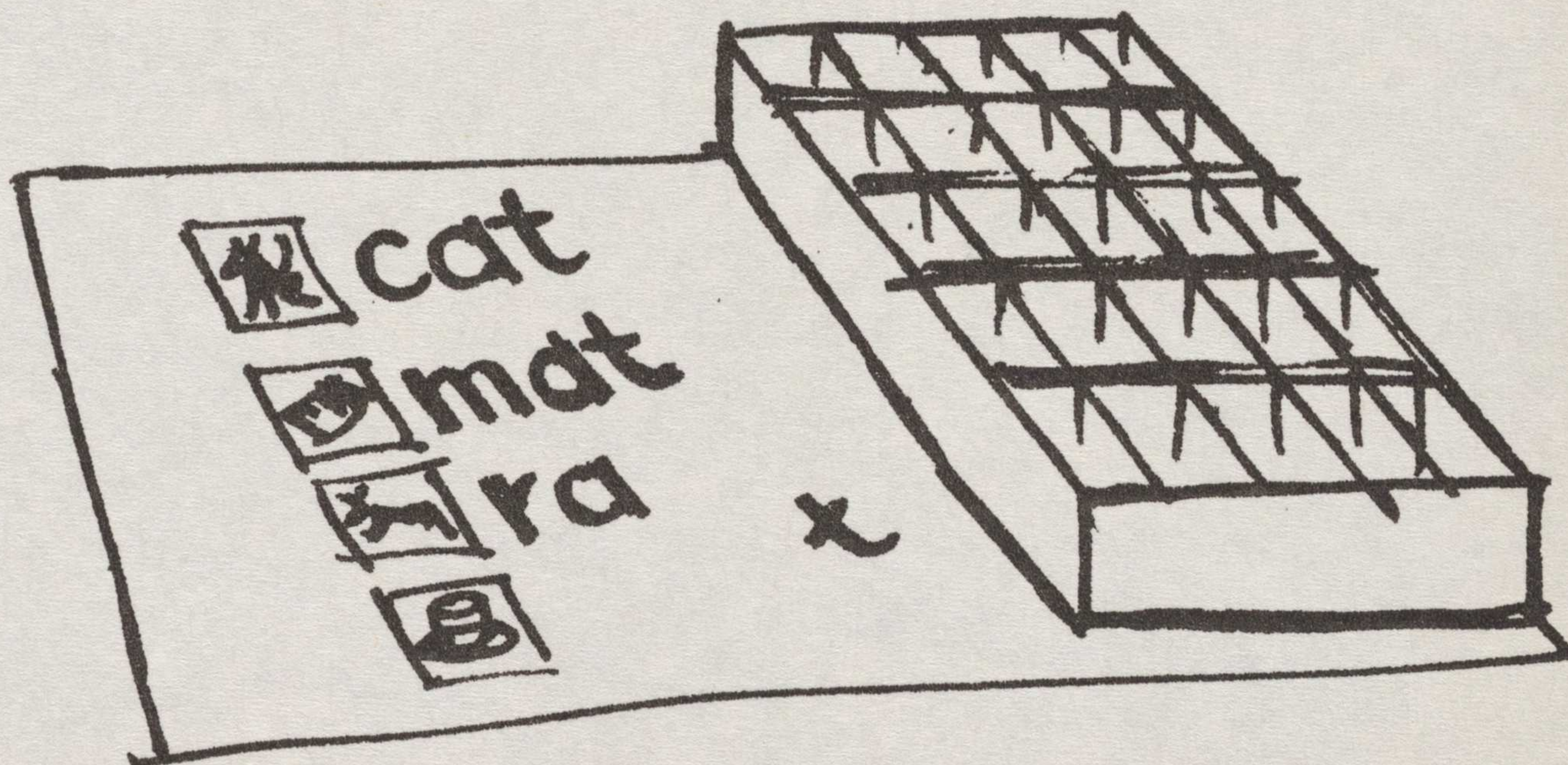
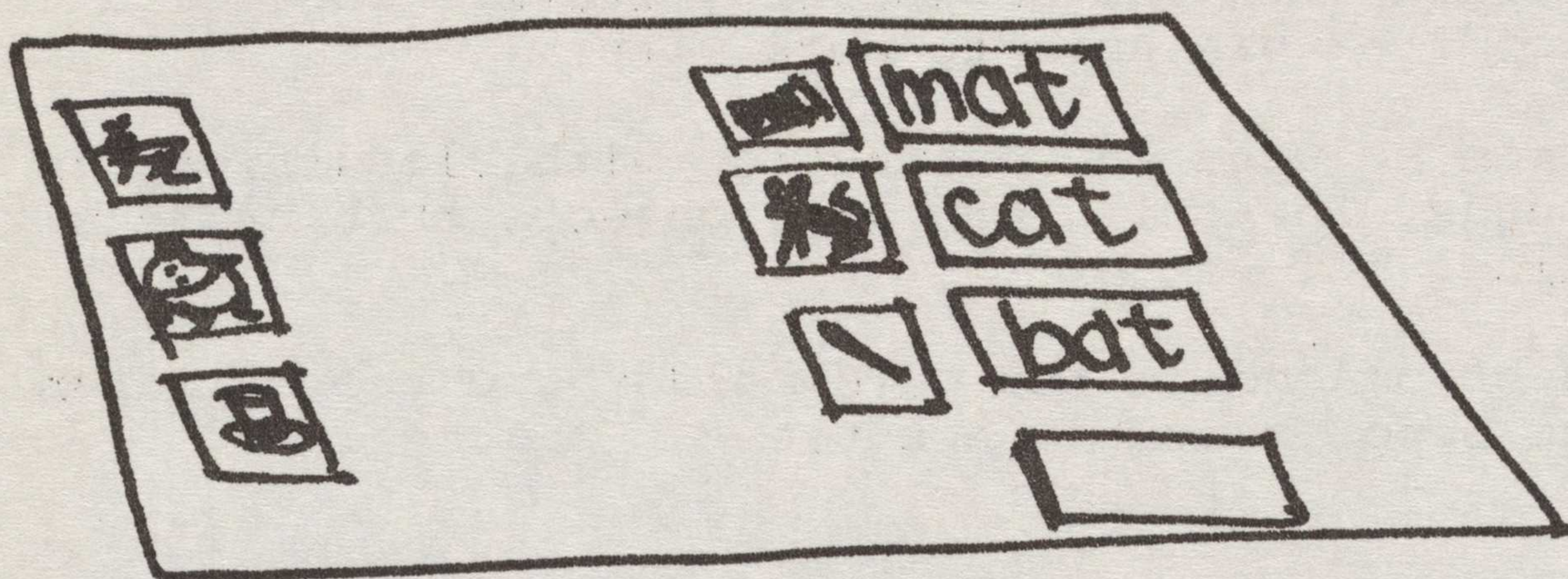
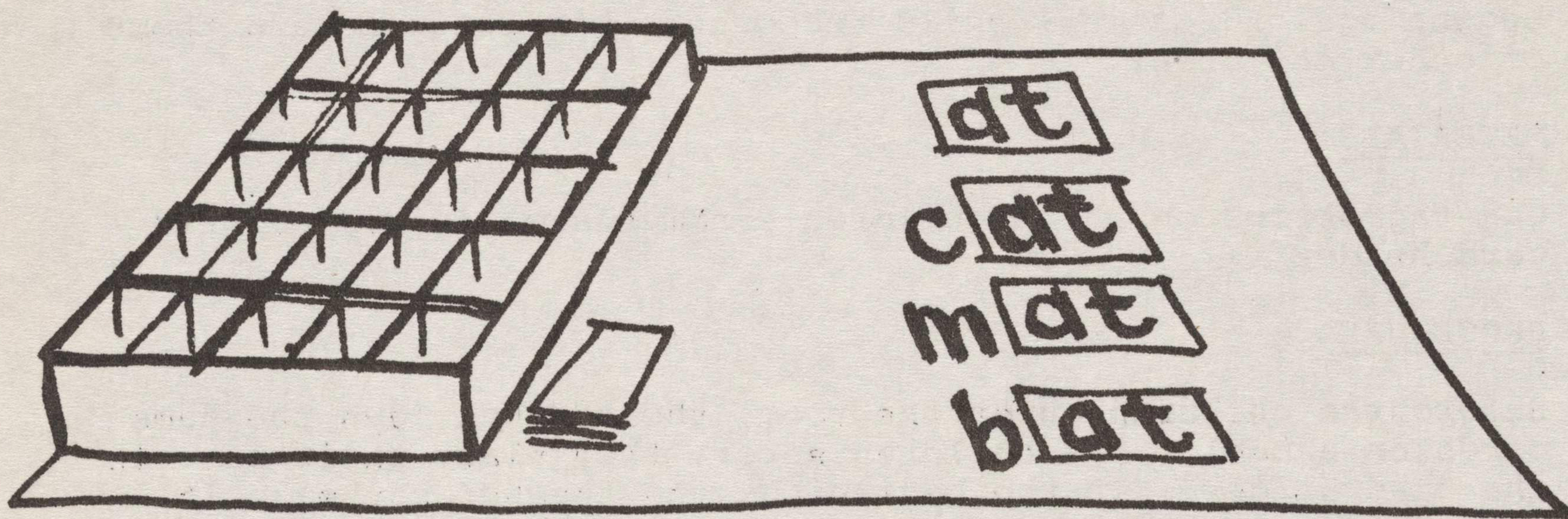
ADDITIONAL

The name cards can be used as models for writing or as a springboard for work with the sandpaper letters. The child can choose one letter from his name to work with.

The name cards can be used in conjunction with classification of consonant sounds. The child can sort objects that begin with the same sound as his name.

Photographs can be placed in the card holder and the children place their name opposite their picture.

Introduction to word Patterns



III. BEGINNINGS OF READING

A. INTRODUCTION OF WORD PATTERNS

PURPOSE To teach reading as decoding of word structures.
To teach child to recognize and read regularly spelled words.

MATERIALS 1. Cards with word pattern printed on them; moveable alphabet
2. Set of objects or pictures representing words spelled with a certain pattern, set of corresponding word cards
3. Set of pictures, moveable alphabet
4. Workbook pages, plastic envelope, grease pencil, small cloth to erase.
5. Word cards and booklets

PRESENTATION

1. After the child has shown interest in the alphabet work and seems ready to go ahead, teacher shows him a simple word pattern printed clearly on a small card.

"This says ____ (e.g. at) Let's make some words."

The teacher takes an initial consonant from the moveable alphabet box, places it before the pattern card and reads the word "cat"...

"We can make some more words. What words rhyme with cat?" (e.g. hat, mat, bat, etc.)

The teacher constructs words with pattern cards and initial letters.

2. The teacher places the pictures or objects on the table, reviews the vocabulary with the child. She then reads through the word cards with the child and matches the words to pictures or objects.

"Would you like to try it?" Child repeats.

Control of error--small picture on back or word card indicates correct match

3. Pictures representing words of a simple pattern are laid on a mat or rug. The word is then spelled out with the letters of the moveable alphabet.

Control of error--word may be typed on back of the picture cards

4. Work Sheets

Workbook pages may be set aside in order of difficulty. The teacher helps the child choose an appropriate sheet. She inserts it into the plastic envelope, says to the child, "Watch how I do it." Teacher underlines or circles the appropriate items with the grease pencil.

"Would you like to do it?"

Teacher erases the markings with a small cloth, and hands the sheet to the child, helping him, if necessary.

Control of error--Child may consult a master copy to check his accuracy.

BEGINNINGS OF READING (CONTINUED)

B. INTRODUCTION OF NECESSARY SIGHT VOCABULARY

PURPOSE To teach the irregularly spelled words that are necessary to formulate simple sentences and stories

MATERIALS Word cards, card holder

PRESENTATION

The teacher can present these words in a group lesson, explaining: "I have some "special" words here. These words don't have a regular pattern. You have to learn how to recognize them by sight." The teacher then puts the word the in the holder. "This word says "the"". The then combines the with regularly spelled words, asking the children to read the combinations with her (e.g. the cat, the mat, the man, the fan, etc.)."

The teacher can present other words in the same manner.

For practice, the teacher can make cards with phrases and short sentences to be read by the child. Larger cards could be made for practice with a group of children.

Sentences & Stories

I



The man ran.



Dan ran.



Nan ran.

II



The cat sat on the mat.



Dan has a hat.



The man is fat.

III

Dan has

The

is

man

mat

d

on

hat

BEGINNINGS OF READING (CONTINUED)

C. SENTENCES AND STORIES

PURPOSE

Practice in reading

Reading for meaning

Practice in recognition of sight vocabulary of irregularly spelled words.

Recognition of word patterns and development of the ability to generalize from them.

MATERIALS

1. Work sheets, plastic envelope, grease pencil, small cloth.
2. Sets of pictures with sets of corresponding descriptive sentences.
3. A group of separate word cards which can be combined to form one or more sentences, envelope to hold cards, table or floor mat.
4. Beginning readers-either teacher made or commercially available.

PRESENTATION

1. Teacher helps child select workbook page of appropriate difficulty.

She inserts page in plastic envelope and demonstrates correct match of sentence to picture.

She erases and child repeats.

Control of error--Child can compare his page with master copy.

2. Teacher demonstrates correct match of pictures with sentences. Child repeats.

Control of error--Small picture on back of sentence card indicates correct match.

3. Teacher places cards in random order on table. Shows child how sentences can be constructed from the words. Child then repeats.

Control of error--Reading of sentences to see if they make sense

4. Readers of appropriate difficulty are made available to the child. As his ability to read and to decipher words gradually develops, he is encouraged to explore the readers. He is helped to master new word patterns and also irregularly spelled "special" words as they occur.

A. WRITING - PREPARATION

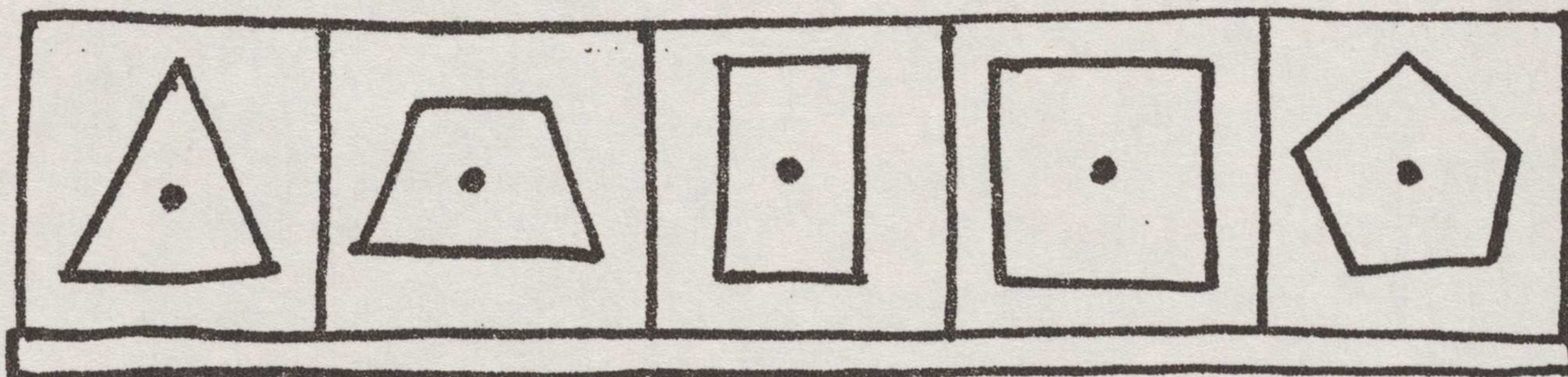
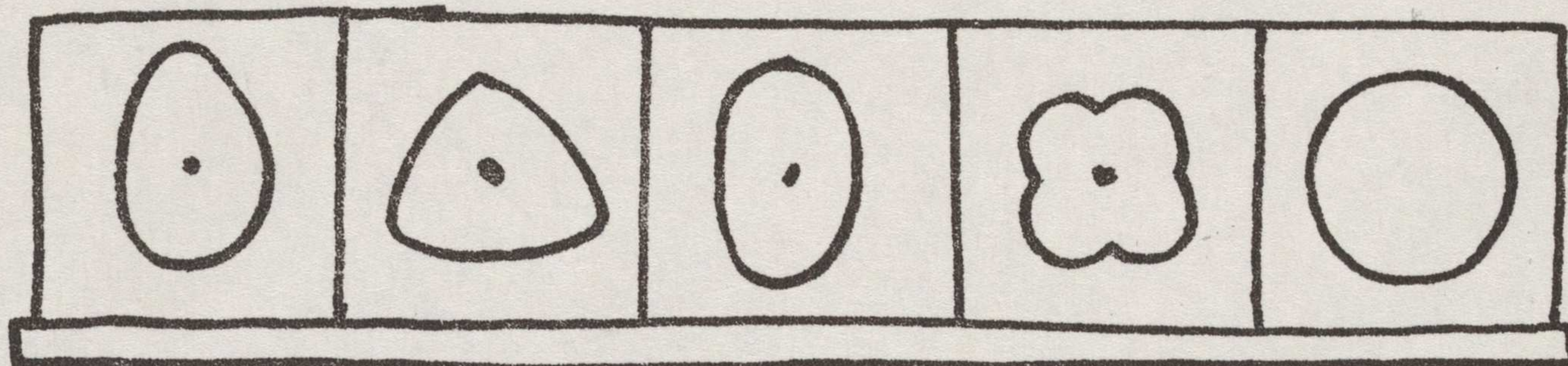
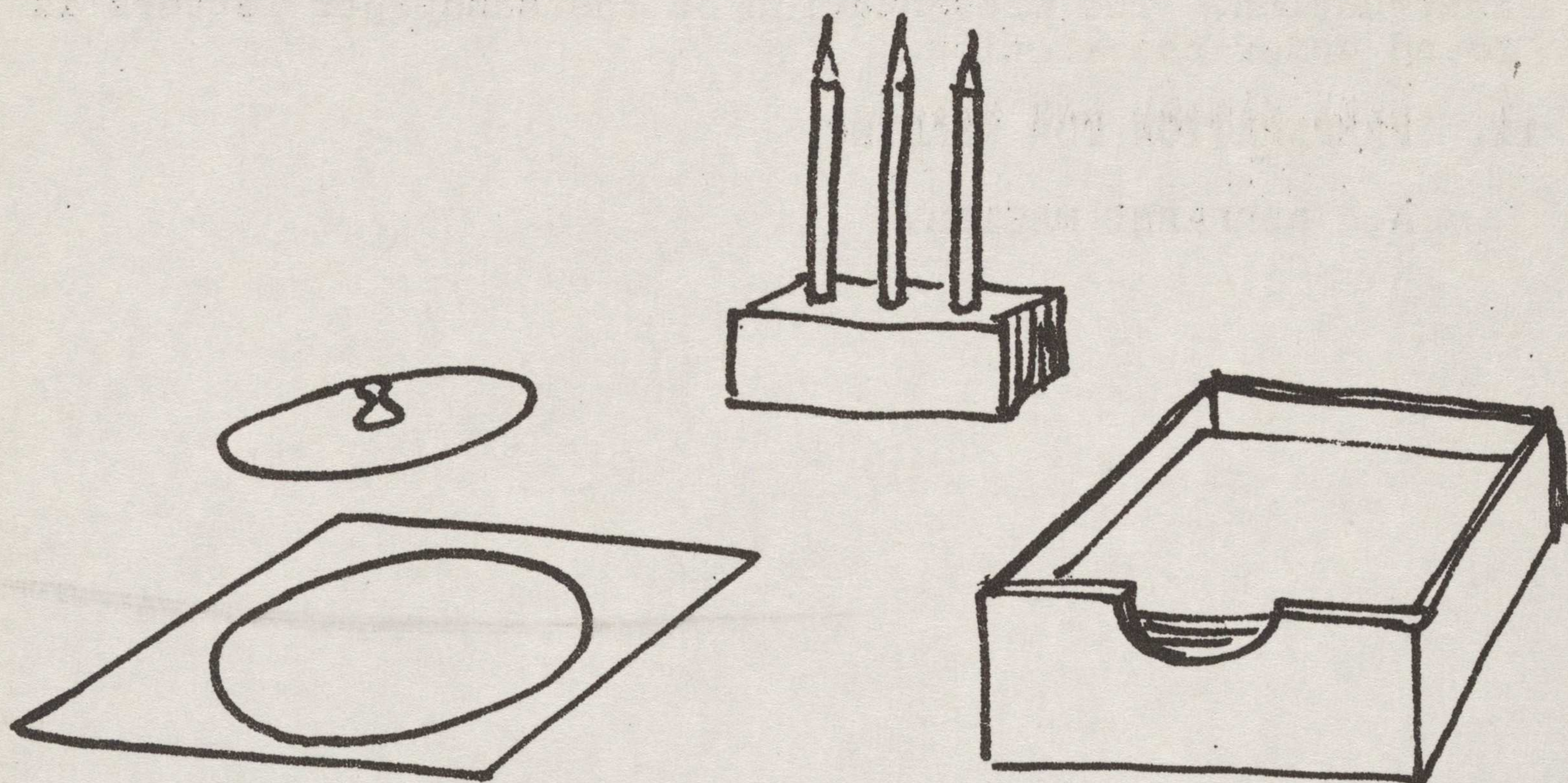
I. SANDPAPER LETTERS

The sandpaper letters, in addition to being a means to mastering the alphabet, also form the basis of handwriting instruction. The presentation of the sandpaper letters is found under the section.

II. PREPARATION FOR READING

A. ALPHABET MASTERY

Metal Insets



WRITING - A. PREPARATIONMETAL INSETSMATERIALS

Two stands with sloping back and a narrow cornice at the bottom on which rest ten square metal frames, into each fits a metal inset. The square metal frames are pink and the metal insets are blue and in their center a little knob, by which to hold them. The ten insets are: the square, triangle, circle, ellipse, rectangle, oval, trapezium, pentagon, curvilinear triangle, and quatrefoil. They have exactly the same measurements as the geometrical insets in wood.

A board about 20 centimeters square and a plentiful supply of square sheets of paper, a set of three colored pencils and a tray.

PRESENTATION

To begin with, take the metal frame of the square. Place a square sheet of paper on the wooden board, and place the metal frame on it without its inset. With a colored pencil draw around the contour of the empty space of the cut-out. Now lift the frame and the figure is reproduced in one color on the paper. Now take the inset and place it as exactly as possible within the figure drawn on the paper. Hold it firmly down with the hand while with the other hand draw around the contour of the inset. Lift the metal piece and see its shape outlined in two different colors.

After this, with a colored pencil, holding it in the manner of writing, he fills in the figure he has outlined. To achieve the best effect, use gently backforward and forward back strokes. Encourage to make parallel lines going from one end to the other of the inner figure. Ask the child to see if he can fill the whole figure without ever passing beyond the line of the inner figure.

At a later stage the child may superimpose different figures, using only the insets in any manner of design that the child may wish to create, filling in the different spaces with colors of his own choosing. His creative activity will awaken of itself as he learns to control his pencil.

PURPOSE

Indirect preparation for writing. He prepares for the muscular control necessary for the mechanism of writing by learning to wield his pencil, directing it where he wants it to go. Filling in the single shapes at first gives him greater freedom to move his pencil. When he has learned to control his pencil, he will set himself further limits by more and more difficult and intricate designs. He thus acquires a sense of geometrical design and his artistic sense is stimulated.

CONTROL OF ERROR

To keep within the lines.

AGE 3 - 5 years.

AIM

To acquire mastery of the hand in wielding a writing instrument both in lightness and keeping within any limits.

WRITING - B. PRACTICE

1. USE OF BLACKBOARD AND LARGE SHEETS OF PAPER

PURPOSE

Practice in forming letters correctly
Muscular coordination

MATERIALS

Large blackboard area and chalk or large piece of paper and magic marker.

Sandpaper letter

PRESENTATION

Teacher demonstrates proper stroking of sandpaper letter. Child strokes letter then writes it on blackboard or paper.

An exploratory stage can precede this presentation where child uses medium freely, then to make circle and lines in various combinations.

Later, child can draw letters without stroking sandpaper model.

2. PRACTICE SHEETS

PURPOSE

Perfection of writing technique
Further practice in correct formation of letters

MATERIALS

Work pages, plastic envelope, grease pencil, small cloth

Variation--small booklet of letter models, tracing paper of a matching size, soft lead pencil.

PRESENTATION

A workpage of appropriate difficulty--single letter or more than one letter-- is inserted in plastic envelope. Teacher demonstrates, drawing over solid and dotted lines of models and then free form as indicated on the work sheet.

Variation--Teacher demonstrates placing of small sheets of tracing paper over page on which letter model is printed. She traces letter, removes paper. The child repeats the procedure. The child's finished work can be stapled together to form a booklet.

WRITING - B. PRACTICE (CONTINUED)

3. STRUCTURED PAPER

PURPOSE

Practice in writing in a defined area
Practice in writing letters of proper proportions
Practice in noting parts of letters falling above or below the line

MATERIALS

Paper divided into approximately 3/4 inch squares with writing guidelines indicated, soft lead pencil, sandpaper letter or name card.

PRESENTATION

1. Child explores and familiarizes himself with medium. Teacher shows child how he can draw circles and lines in various combinations and patterns in the squares. Child repeats.

2. Child chooses a sandpaper letter or letter from his name which he would like to practice. Teacher draws models in the squares. Child repeats.

4. NAME BOOKLETS

PURPOSE

Practice in correct formation of letters in child's name
Perfection of the child's writing of his name

MATERIALS

Cardboard with model of child's name written on structured paper on upper half. On lower half is space where child's finished work can be stapled to form a booklet and a record of his progress, single strips of structured paper, soft lead pencil.

PRESENTATION

Child takes cardboard with model of his name attached and a piece of structured paper to a table. He can choose to practice one or more letters from his name. Teacher demonstrates writing of letter(s). Child repeats. Finished line of child's work is stapled to lower half of cardboard to form a booklet of finished work.

OBSERVATION

SUGGESTIONS FOR OBSERVING AND RECORDING CHILDREN'S BEHAVIOR

What You Will See

While you will be given specific suggestions for what to look for and how to set it down, it is our hope that you will gain new insight and understanding beyond what is in any of your records through the opportunity of seeing many children - each unique and trying to work out his personal relationship to life - under contrasting conditions of supervision and with varying resources at their command. The total experience, of many observations, may help crystallize your personal understanding of the problems of human development in our civilization.

To a sensitive observer a child's behavior is always meaningful and informative. You will have a chance to see what some hundreds of children collectively and individually can tell you - through their remarks and behavior - about what it means to grow up, to be a middle child, to have an over-strict or a genuinely sympathetic teacher, to be sick and away from home, to have difficulty in learning to read, to have a father in the army or to try to be "clean and good".

How We See

Any observation is always selective. What we pay attention to, what we notice, what we actually see and what we remember is determined by all of our past experience and what we are consciously or unconsciously expecting to see. Moreover, observation always involves interpretation. All behavior, all situations have a definite personal meaning. We not only see some things and fail to see or remember others but what we see is always translated and transmuted to fit the personal values and experiences that we bring to the situation.

Thus the first thing to emphasize in learning to "see" is that this is not a simple, automatic procedure comparable to starting a movie camera. Psychologists have demonstrated that in the act of perception itself there is always an arbitrary selection and grouping of stimuli. It is almost impossible to look at a cloud or an ink blot or a series of cracks in a ceiling without giving them an organized pattern of some kind that is in no way inherent in the stimulus. And the pattern that you find or impose is different from someone else's. The fascinating studies of optical illusions are further dramatic demonstrations that we do not passively receive information through our senses but actively work it over. Particularly important is the tendency present in everyone to go even further and fill in what is not there. The well-known proofreader's illusion shows that if a word like WASHINGTON is shown very quickly the subject will report that he saw WASHINGTON - actually supplying the missing letter himself.

How We See - cont'd

Experiments on the psychology of testimony offer even more vivid evidence of the way in which we select and interpret our experiences; of how we omit, distort and fill in our observations.

Dashiell quotes the following reports of an incident in which a prominent politician was struck in the face by an actress on the stage of a New York theater:

<u>The World:</u>	"Slashed him viciously across the cheek with her gloves."
<u>The News:</u>	"Struck him on the left cheek with the bouquet."
<u>The American:</u>	"Dropped her flowers and slapped him in the face with her gloves."
<u>The Times:</u>	"Slapped his face vigorously with her gloves three times."
<u>The Herald Tribune:</u>	"Beat him on the face and head...a half-dozen blows."
<u>The Evening World:</u>	"Struck him across the face several times."
<u>The Daily Mirror:</u>	"Struck him a single time."
<u>The Evening Post:</u>	"Vigorously and accurately slapped him."

J. F. Dashiell, Fundamentals of General Psychology, 1937, p. 429.

Particularly serious is the fact that we cannot accept meaningless scraps of sound or action but always alter them to fit in with our understanding (or misunderstanding) of the total situation. The rumors of "invasion jitters" are based on this principle: a cow in the twilight may be seen as a parachute detachment. The influence of our interpretations or "sets" or "frames of reference" is seen, too, in experiments which show that in a series of statements about women, more favorable ones will be recalled by women while men will remember relatively more unfavorable statements. Similarly, those with favorable attitudes to Negroes are found to recall favorable statements better.

All of these factors obviously affect observations of children's behavior. It is impossible to avoid some degree of organization, interpretation, selection and omission of data. A person who is not aware of the importance of autonomic disturbances may not notice pallor or frequent urination; someone who is "set" to look for aggression will find it more frequently than one who is not; moreover, the aggression will look different if it is the fetching behavior of a "cute" child rather than a sullen action by a child who is not attractive to you. This matter of attractive-

How We See - cont'd

ness is also highly individual: one student will prefer a child who reminds her of her own childhood self; another likes children who are dependent upon her; another prefers vigorous children and some one else likes the highly verbal, adult-oriented child best. But this choice, deeply personal, and rooted in past experiences, alters the way each child's behavior looks to each observer.

Add to all this the difficulty of conveying verbally what one does see and remember; the difficulty of passing on to someone else what has come to you through your personal filtration system - and it will be clear that the task of observing and recording children's behavior involves many pitfalls.

On the other hand, there are certain advantages to the human characteristics that can cause so much difficulty. Fortunately, the human observer - particularly as he becomes trained in the field in which he is observing - can select the significant from the trivial; he can interpret and organize his observations so that meaningful patterns appear instead of a useless congeries of unrelated and unrelated items: The better trained he is the more dependable is the pattern he describes, and the less influenced by his irrelevant past experience.

Accurate Recording

It is not possible to abolish these human frailties, but it is possible to turn them to best effect and to minimize their accidental influence. The first and most effective means for accomplishing this is to be clearly aware of the fact that purely "objective" recording is a near-impossibility, and can only be approximated by taking a number of specific steps: just "setting down what you see", it is now obvious, is no assurance of objectivity or of accuracy.

Where the utmost in objectivity is sought it is well to keep in mind the hazards of perception and memory and our quickness to interpret. Not only when actually recording but in later preparation of the record it is wise to maintain a healthy skepticism about what you have "seen" and to indicate all questions or doubtful aspects of the record.

It is of assistance, too, to limit and define the behavior to be observed. If the pre-selection of material is careful it is less likely that there will be accidental and personally determined selection during the actual observation. It is possible to decide in advance exactly what items of behavior one is to record and to specify their classification so that a minimum of immediate description and interpretation is necessary.

Repeated practice is of inestimable value in recording. The more behavior one has observed critically and attentively the more coherent and meaningful it becomes. Small children's speech becomes easier to understand; routine and special activities are differentiated more readily and one gradually builds up a picture of what to

Accurate Recording - cont'd

expect of most children of various ages, and in various common situations. And of course, one acquires a very helpful skill in setting down what one has seen: there is less time lost in fumbling for words; cues to significant behavior and attitudes are noted immediately so that they are not lost when the record is later completed; usually one develops a convenient shorthand or system of abbreviations which facilitates setting down what one sees; at the same time it becomes easier to fill in the details.

Very often, however, a type of recording is desired in which there is a deliberate attempt to make use of the more subtle if sometimes less reliable judgments of which a human observer is capable. It is often important to get a summarized, condensed and organized picture of a child or of a situation which can only be supplied if the observer is given some freedom to use his judgment and to conceptualize.

Here, too, it is necessary to keep in mind the tricks that we play upon ourselves when we think we see something; here, too, the amount of practice and skill that the observer has acquired is of the utmost significance-but we defeat our purpose if we set out to limit and define in advance what we are to observe. Here the observer's over-all judgments and even his "hunches" are definitely wanted and to exclude them would be to deprive ourselves of valuable data which could not be supplied by a more mechanical approach. What is important in this type of recording is to be thoroughly aware of what one is doing: to make it very clear where one is speculating and to document and support one's judgments wherever possible with references to specific behavior or facial expressions or other observable data. No hunch ever comes out of thin air and it is necessary to be as explicit as possible about the sources of one's judgments and impressions.

Subjectivity and Objectivity

Once we have agreed that a completely objective record is a human impossibility we have still open to us varying degrees of objectivity. We might, at one extreme, train a group of observers to record a single specific activity whenever it occurs. We might ask them to note the number of times a given child sucks his thumb during a specified period of time. We can give this group of observers enough directed practice so that they will agree in nearly one hundred per cent of the instances on when thumb-sucking actually occurs. As measured by the agreement of observers working together we can achieve almost complete "objectivity." This kind of carefully controlled observation is very useful and meets a number of important needs. Very valuable research on the incidence of so-called "nervous behavior", for example, has been carried out by this means. Sometimes one may wish to compare the frequency of conflicts among different age groups or under conditions of crowding as compared with abundant free space. A teacher might wish to have a reliable index of the relative frequency of crying

Subjectivity and Objectivity - cont'd

among the children in her group. It must always be remembered, however, that with this type of recording the selection and definition of categories must be very rigorously determined in advance and that it must necessarily be carried out at the expense of omitting any observed data that have not been planned for. In many research problems this is possible and desirable.

However, particularly when one is concerned with the study of a single individual and needs to see how various aspects of his behavior fit together, this type of pre-analysis is inappropriate and may prevent obtaining needed information. Here, bits of behavior without their context may be either useless or actually misleading. For example it may be necessary to know whether a child is sucking his thumb only at nap-time or when he is threatened and in a tight spot; one may need to know whether a child who initiates many conflicts is attacking little girls who represent a baby sister to him or is a child who has not yet acquired much verbal skill and therefore has to make his way physically, or whether he is the youngest of nine children and always has to battle for his rights, etc. To meet the needs of research of this type other techniques have been developed which are considerably further over on the subjective side of an imaginary scale of objectivity-subjectivity but which are designed to provide records of behavior in context. It is always necessary to make a conscious and deliberate choice and to recognize the penalties of either choice. One may achieve objectivity at the risk of having no significant information, or one may obtain richly meaningful judgments of children's behavior which are thoroughly undependable and inaccurate. One must attempt to be sufficiently judicious neither to throw out the baby with the bath nor to drown it in the suds. The most objective and controlled type of recording must be used wherever it is appropriate but it must be sacrificed where its yield would be misleading. More subjective records must be used where the breadth of understanding that they offer is necessary, but they must be as thoroughly documented in terms of concrete behavior as possible and their more subjective statements clearly labeled. Such records must be obtained repeatedly and by different observers wherever possible. With well-trained recorders a surprising degree of reliability may be achieved. It is in this type of recording that the most skill and training are required and for that reason you will be given more practice with these records.

Types of Records

There are various kinds of records that may be used in the observation of children's behavior. The history of their development is interesting, and will be discussed later. For the present we may conveniently classify them as follows:

- A. Refined Diary Records: 1) Impression records
2) Recall records. 3) Running records. 4) Summary records
- B. Short Sample Records.
- C. Rating Scales.

A. Refined Diary Records

These records are named as they are because they bear a basic resemblance to the early "diary records" of the first days of research and recording in the field of child study: they frankly include the direct personal judgment of the situation that can only be made by the observer on the spot. Because of the precautions to secure accuracy and objectivity that have been added, however, the term 'refined' has been employed to distinguish this type of record from the earliest diary records.

1. Impression records.

Impression records are the most subjective of all the types of recording used. They are intended to preserve - or to elicit - the observer's personal judgment of a child or a situation.

Most frequently such a record is a "first impression" for it has been found that such first judgments, before the observer is clogged and hampered with too much detail, often contain accurate insights: almost always such judgments can provide useful hypotheses for organizing and planning further observations of the child or situation.

All records, of whatever kind, partake of direct observation and of interpretation of such observation, in varying combinations. It has already been suggested that one can not take place without the other, but they may appear in varying degree. The primary emphasis in the Impression record is on the interpretation. Sometimes the interpretation may be so far removed from direct observation that we are unaware of the relevant observation, and speak of our 'hunches' about a child. Here the task is clear: The pure impression is not a datum to be discarded or ignored; it is one to be refined and objectified and supported by citation of relevant behavior.

Thus the Impression record will consist primarily of your judgments and interpretations of the child. In support of these it is desirable to cite specific behavior, expressions and remarks. This is not always possible at once: it may be the task of future, more direct observations and more detailed recording of behavior.

2. Recall records.

Recall records are like Impression records in depending on your subsequent recollection of significant behavior, rather than direct, immediate recording (as in a Short Sample or Running record). Their emphasis, however, is on specific behavior and events, with the interpretation distinctly secondary.

Recall records are regularly used by teachers who wish to keep some kind of day-by-day or week-by-week records for later compari-

Recall records (cont'd)

son, but who do not have the time to make full Running records. When you are participating in the nursery school laboratory you are largely limited to this kind of record, for you are not at liberty to give full attention to pencil and notebook rather than to children on jungle gyms or in conflict over tricycles. The more complete kinds of records must be made in non-participation hours.

You may find it useful to note a word or two of the action or conversation you wish later to record, but this is only as an aid to memory. The actual writing and preparation of the record take place later: as soon afterwards as possible. In your record you may call attention to a specific event of a child's day that seemed significant to you, or you may wish to describe a continuing or repeated activity that you have noticed. Give as much detail as possible: be careful, however, not to state anything more definitely than you clearly remember. Be particularly wary of direct quotations where you are not absolutely certain of them. You will find that repeating phrases to yourself as soon as you hear them, or verbalizing an activity you wish to remember immediately after it occurs will help you in later record writing.

3. Running records.

Running records are at once the most difficult and the most valuable records that you will make. Here it is your task to record so fully, so thoroughly and so vividly that you reconstruct the scene you have observed. You must actually freeze what you have seen in writing - not only for your own future reference but for the benefit of someone who was not there at all and for whom you must re-create the event. This is a task demanding objectivity and accuracy but at the same time it is a difficult exercise in descriptive writing.

As has already been made clear a completely objective reconstruction cannot be achieved: the prime requirements are for you to see what happens in as clear and unbiased a manner as possible and then to communicate what you saw and felt as fully and vividly as you can. It is not the objective situation that you are describing but the situation-as-you-saw-it and as it has been filtered and distorted through your perceptions, attitudes, ability to recall and ways-of-feeling about children. To recognize this is not to surrender all claim for objectivity or any attempt to achieve it but to understand what stands in the way and to know what aspects of a record can be most useful. It is a recognition, too, that a statement of what the situation meant to you; of how you felt about the child's behavior is an essential part of the whole picture, even though it seems at first glance to be the most "subjective" part.

For if we recognize that the record is always personally toned we can demand that this be made as explicit as possible.

Running records (cont'd)

The more complete a statement we have of the impact of the event on the observer the better we can place ourselves in the situation. Moreover, if the observer's point of view is clearly stated and does not merely peep out between the lines the reader has a better opportunity to dissociate it from the actual events and to discount it as much as we think necessary. For example, if the recorder lets us see his strong preference for a certain child or expresses honestly his distaste for a certain kind of behavior, he is doing what he can to specify the "lenses" through which he has observed and permitting us to make any necessary corrections for his way of seeing. In just the same way, if a photographer specifies the light conditions, the lens used, the shutter speed, the distance from the subject, etc. we can reconstruct the original scene more accurately than if we have only the finished photograph to go by. Thus a complete, objective and subjective statement of the situation observed is more informative and is even more "objective" than one which seeks a false objectivity by merely ignoring the subjective factors which necessarily enter into the record and pretending they are not there.

A good running record should include the gross activities of the child in a clearly stated context and within a definite time framework. By gross activities are meant the actual locomotions of the child; where he is, where he goes, what he does, what he says and to whom he says it. The setting and background should be stated and the passage of time clearly indicated.

Johnny has been riding a tricycle with two other children since rest-time. Three other children whom he has largely ignored are having a parade near the sand-box. The others, including his special friend Dick, are absent today. One teacher is in the cloak-room; a student stands near the sand-box.

2:27 John rides behind Carol, occasionally saying
"beep-beep" and almost bumping into her. He stops
2:28 suddenly and watches the 'parade' (one of the children
is clanging pot-cover cymbals together). He gets off
2:30 his bike and runs over to the 'parade' group. Shouts,
2:31 "Hey, I'm a soldier!" He picks up a stick and falls
in line between Edith and Billy.

This record of gross activities usually focusses on the child's adaptive or purposive behavior and tells what he does and how he occupies his time. Often, however, such a record is incomplete just because it is likely to omit non-adaptive behavior - the inconsequential but highly expressive movements and activities of the individual. We want to know what the child does, but we want our records also to tell what kind of a child this is.

Running records (cont'd)

To be sure, the content of activities tells us something of this. The child who is constantly riding a bicycle and climbing the jungle-gym is different from the child who is usually swinging, rocking and pushing a doll-carriage. But to understand the child better we need a more complete record and the second step is to give the finer details and the non-adaptive aspects of his behavior. Thus (the times are omitted in these examples):

Johnny has been riding a tricycle with two other children since rest-time. He constantly glances around him as he rides, and hunches his shoulder as he approaches other bikes. Three other children whom he has largely ignored are having a 'parade' near the sand-box. The others, including his special friend Dick, are absent today. One teacher is in the cloakroom; a student stands near the sand-box.

John rides behind Carol, occasionally saying "beep-beep" and almost bumping into her. He stops suddenly and watches the 'parade' (One of the children is clanging pot-cover cymbals together), frowning, rubbing his cheek and shifting his feet on the pedals. He is flushed and perspiring. He gets off his bike with sudden and superfluous energy, knocking the bike over and leaving it in his wake. His arms and legs go out from his body in wide sweeps as he runs, knocking over a doll-carriage as he goes. Shouts, "Hey, I'm a soldier!" He picks up a stick and falls in line between Edith and Billy.

The inclusion of these details and expressive movements helps one to visualize the child's activities far better than is possible from a mere record of gross activities and locomotions. But still more is needed to round out and complete the picture of the individual if this behavior is to be presented vividly to someone who has never seen him before. We need to know not only what he does but how he does it.

The addition of the "fine details" begins to round out the picture of the "how" but it is necessary to convey the quality of behavior; to characterize it in such a way that the personal stamp of the individual, always visible in all his actions, is also conveyed in the record. Sometimes using an apt and vivid verb rather than a general one will accomplish this; sometimes descriptive phrases and adjectives must be used:

Johnny has been riding a tricycle with two other children since rest-time, tramping the pedals in his

Running records (cont'd)

characteristic, superenergetic fashion, emphasizing energy rather than precision and often missing a pedal for a half-turn. He constantly glances around him Challengingly (as though expecting interference?) as he rides, and hunches his shoulder (protectively?) as he approaches other bikes. Three other children whom he has largely ignored are having a 'parade' near the sand-box. The others, including his special friend Dick, are absent today. One teacher is in the cloakroom; a student stands near the sand-box.

John rides behind Carol, occasionally saying "beep-beep" and almost bumping into her. He stops suddenly and watches the 'parade' (one of the children is clanging pot-cover cymbals together), frowning, rubbing his cheek and shifting his feet on the pedals. He is flushed and perspiring. He is utterly relaxed now, his body limply poured and draped over the tricycle - all his exuberant energy turned off as by a switch. Now he is completely oblivious of the other bikes, even when one jars his own. Just as abruptly the switch is turned on again: he gets off his bike with sudden and superfluous energy, knocking the bike over and leaving it in his wake. His arms and legs go out from his body in clumsy and violent wide lunging sweeps as he runs, his arms held awkwardly, elbows close and fingers spread wide, face very intent and tongue protruding from the side of his mouth; he knocked over a doll-carriage as he goes. Shouts stridently, voice pitched high, "Hey, I'm a soldier". He picks up a stick (gun?) and falls in line between Edith and Billy....

Finally, it is important to add your impression and interpretation of the behavior you have recorded making it perfectly clear how you have seen it. In a few instances this has been done parenthetically above. For example -

Johnny's behavior in this episode is a good sample of what can be seen every day. He shows remarkable focus on what he is doing - usually completely shutting out everything else that is going on. He is remarkable for his energy and wholehearted attack on whatever he is doing, putting his soul into it completely. For so vigorous a child his ability to relax is surprising: he is either completely in action, using every bit of himself, or utterly passive and quiet. These relaxed interludes seem to come at regular intervals (this needs to be checked) and usually occur when he has finished one thing and is about to start something else. He rarely "flits" from one thing to another: there is generally a clear beginning and end.

Running records (cont'd)

It seemed to me that he had a chip on his shoulder today. He seemed to expect interference from the other children on the bikes and once or twice ran his bike into theirs as though to see what they would do about it. Also, when he joined the parade, it looked to me as though he expected to be rejected by the other children: he announced his intention to join them belligerently and he almost shouldered his way into the group.

Note the importance, for example, of the last paragraph. The quality of belligerence might not be evident without specifically calling attention to it, yet it may be the most important point of all in understanding Johnny's behavior at this time. The interpretation may even be erroneous, but it can be checked against other evidence. A pseudo-objectivity which omitted this interpretation would simply deprive us of what might be our most significant information. At the same time, even if we assume that the interpretation is not correct, it may tell us a lot about the child. It might, for example, indicate how very intensive an energy-output Johnny shows - so that to someone who does not know him very well even his ordinary actions show so much drive that they seem hostile.

Running records may have a variety of emphases since utter inclusiveness is not possible. The recorder may (where there is a great deal happening) choose to emphasize the actual activities or to record conversation verbatim. Or, the recorder may summarize these aspects and concentrate on mood and facial expression, or he may attempt to present the individual quality of action as vividly and in as much detail as possible. The nature of the situation and the specific purpose of the record will determine the proper emphasis.

In the examples above it has been assumed that you are recording the behavior of a single child. A group running record is no different, except that a higher degree of selectivity is necessary in order to keep the material manageable.

Many of the difficulties of a running record are purely mechanical: how to get everything that is happening down on paper. The most important aid here is selectivity; not selectivity in the sense of deliberate omission, but a clear decision about what is to receive detailed attention and what is to be recorded summarily. You may decide, for example, to note only the sense of what is said, or you may elect to give conversation verbatim and give only cursory treatment to accompanying actions.

Nevertheless, recording of this type "takes on many of the aspects of court reporting, with the added difficulty that it requires not merely mechanical speed and skill but judgment and sensitivity on the part of the observer." It is essential to be

Running records (cont'd)

free of encumbrances and to have a prepared notebook, so arranged that one does not need to look at it as one writes but can devote all one's attention to the child. Abbreviations and symbols for common words and objects on the playground are very helpful. "Frequently the recorder's greatest difficulty is not in setting down actual words or obvious locomotions and activities, but in noting the subtler characteristics of movement and expression which serve to convey the child's mood and the emotional import to him of the events taking place. It is usually safest to set down some cue word or phrase along with some marginal indication that will readily catch the eye and not risk the danger of falling behind the whole action in seeking the mot juste. Immediately after the event the recorder can look for these cue signs and while the events are still fresh, elaborate the description as necessary." (L. J. Stone, Group play techniques, in Monogr. Soc. Res. Child Develpm; 1941, 6, #30, p. 105).

Whenever possible the recorder should go over the record immediately, filling in in this fashion, making sure that everything is legible and adding the interpretation. Only then is it safe to set the record before transcription, if necessary.

4. Summary records.

The purpose of a summary record is to draw together the outstanding, characteristic attributes and behavior of a child over a period of time and to indicate shifts and changes in these. Usually it summarizes the information of daily behavior records, impressions, etc., and orders these systematically. Parenthetical cross-reference to the actual behavior records and some quotations from these are very useful. Often the summary record does more than repeat briefly what is in the fuller daily descriptions: e.g., it may be found that apparently insignificant behavior is frequently repeated, thus indicating its great significance to the child (thus in one instance the almost compulsive quality of hand-washing in one 4-year-old was found through its insistent re-appearance in the records); or, a long-range trend of behavior may appear. (in one child's records it became apparent that there was more and more tension and difficulty in playing with others, but this had happened so gradually that it was almost unnoticed. Comparison of records at the beginning of the year made the trend perfectly obvious).

B. Short Sample Records.

In the face of the difficulties in objective recording that we have already discussed one group of investigators has turned to the technique called short sample records. These records cover pre-determined short periods of time and involve the notation of pre-determined items of behavior only. If conflicts, for ex-

Short Sample Records (cont'd)

ample, are to be studied, a plan is worked out for sampling various periods of the children's day in various activities, repeated often enough to give representative findings. An arbitrary time period - perhaps the first five minutes of each hour - is selected and the occurrence (not description) of all conflicts during this period is noted. All analysis must be done before the observation: in this example it may be planned to have separate columns for "quarrels over toys", for "unprovoked aggressions," etc. This type of recording is highly reliable when observers have been trained and there is clear agreement on the definition of each item of behavior.

As we have earlier suggested (p.4) this method may conceal rather than reveal information - especially when we need meaningful sequences of behavior in full context. On the other hand, where it is appropriate and where the pre-analysis of the situation has been skillfully and thoughtfully made this method is a powerful and accurate tool.

C. Rating Scales.

The rating scale represents an attempt to make objective and usable the most subjective aspects of observations: the observer's personal judgment and interpretation of a child's behavior. Like the short-sample record, however, it attempts to achieve objectivity by supplying a common framework for all judgments; a pre-analysis of significant attributes of behavior. Each attribute or trait is defined as clearly as possible, and each child is thought of as showing more or less of the trait in question as compared with the "average" child. Occasionally a mere checklist of behavior items is supplied, but usually a quantitative scale is offered for each trait.

The most successful scales or inventories are those which remain closest to actual behavior and which define each point of the scale with actual behavior descriptions.

While, unlike the short sample record, the rating scale deals with the most significant rather than the most easily observable aspects of behavior, it shares many of the qualifications that must be applied to the short samples. Since it is conceived in terms of traits common to all children, distributed quantitatively from most to least according to the normal distribution curve, it is extremely useful in comparing different groups of children, or in finding the standing of a particular child in the mythical "population" of children-at-large." However, it fails to show the unique interrelation of traits that characterizes each individual taken by himself, and may fail to include what is a rare trait in most children but may be Johnny's key characteristic.

OBSERVATIONS

-14-

A re-examination of all the methods will suggest that even at this early stage in the development of methods for the study of behavior there are many tools at hand. The trained observer can use them all, and is most keenly aware of the fact that each is appropriate in certain situations and for certain purposes. The skillful student of behavior will always consider what he is looking for and the conditions under which he can look and will select the right instrument.

Instruction Sheet for GROUP IMPRESSION Record

Recorder's name
Course and section
Type of record

Date & time (inclusive)
School and group
Place

1. Describe the general setting and situation.
2. How many children did you see; of what ages; how many were away?
3. How many children left and how many returned while you observed?
4. How many adults were present at a time; how many adults came and went?
5. How many different activities were going on at one time? What were they?
6. What part did the adults take in the activities?
7. What degree of freedom did the children have to use various equipment; to go where they chose?
8. What restraints were there upon the children; how were they applied?
9. How much of the activity was initiated by the adults?
10. What was your impression of the general "atmosphere" (relations of teacher to children; relations among the children; crowding or roominess, etc.)?
11. Were conflicts rare or frequent? How many children did they involve? How were they handled?
12. Other comments-

Instruction Sheet for IMPRESSION Record

Recorder's name
Course and section
Type of record

Child's name and age
Date & Time (inclusive)
School and group
Place

Others present; general situation

(The following items represent basic information about a child. You may either fill in the blanks or write in your own style, using the items as a check - list in order to determine possible omissions. You will not be able to obtain all this information in a first observation)

1. Salient characteristics - (What kind of a child is this?)
2. Physical appearance - (Coloring, size-for-age, body-build, carriage, general appearance, etc.)
3. Most successful in (Forte) - (e.g. - verbal, manipulation, large-muscle, social skill, etc.)
4. Manner - (Tempo, vigor, deftness, smoothness - clumsiness, gait, expressiveness, etc.)
5. Mood - (Generally cheerful, morose, variable, withdrawn, etc.)
6. Social relationships - (include naturalness or self-consciousness in being observed; position in the group, etc.)
 - a. With adults -
 - b. With children -
7. Chief activities, satisfactions and skills -
8. Avoidances -
9. Comfort devices -
10. Other comments -

Instruction Sheet for RECALL Record

Recorder's name
Course and section
Type of record

Child's name and age
Date & time (inclusive)
School and group
Place

The chief purpose of a RECALL record is usually to provide a record of a) particularly striking or characteristic behavior, or b) an important behavior sequence or sustained mood or activity through an hour or day or week. You may also include as much as you wish here of the material on the IMPRESSION Record, supplementing and completing your picture of the child. For each of these use only the relevant items and include only significant behavior and details. Keep the child in focus.

A. Record of Behavior Incident

1. What happened?
2. How did _____ feel about it?
3. What had been going on just before?
4. What happened right afterwards?
5. Who else was present?
6. What effect did it have on the others or _____'s relation with them?
7. What did the adult do?
8. How characteristic of _____ was this?

B. Record of Behavior Sequence

1. What happened? (including specially significant behavior sequences and interrelationships)
2. How did _____ feel about it?
3. What effect did it have on _____'s relations with others?
4. Was there anything new?
5. How characteristic was _____'s behavior?
6. What was _____'s manner and mood through this period?

OBSERVATION

Herbert F. Wright of the University of Kansas describes six established methods of observational child study in his article "Observational Child Study" printed in Handbook of Research Methods in Child Development edited by Paul H. Mussen, New York: John Wiley and Sons, Inc. 1960. An abstract of his summary allows us to see various patterns in what and how much observers look for (material coverage), in the lengths of time the observer chooses to observe (continuum coverage), in the techniques used for recording, in the uses to which the records are put (methods of analysis), and in the aims motivating the observer.

Material Coverage (What and how much looked for).

- 1) Open: Recordings are made according to what happens.
 - a) Diary: an individual's developmental characteristics are periodically summarized.
 - b) Specimen: everything that happens in a single period of observation is narrated consecutively on the spot.
 - c) Field Unit Analysis: all events occurring are titled and timed for later amplification and analysis.
- 2) Closed: only specific phenomenon are observed.
 - a) Time sampling: Frequency and duration of a kind of behavior occurring in a group is observed.
 - b) Event sampling: A particular kind of situation is described when and where it occurs and these descriptions are collected for later comparison.
 - c) Trait rating: An individual person is measured against a list of characteristics.

Continuum Coverage (Length of time chosen for observation).

- 1) Diary: longitudinal coverage; usually periodical summaries over a period of several years.
- 2) Specimen: One session; from a few minutes to a "day in the life of..."
- 3) Field Unit Analysis: A session of intense observation divided into intervals of time based on events as they occur.
- 4) Time Sampling: A session of observation in a group, in which individuals are watched in rotation for a set interval of time

- 5) Event Sampling: A series of single events of one kind are gathered, usually over a long period of time: many days or years depending on the frequency of the event's occurrence.
- 6) Trait Rating: an interview or a period of recall based on knowledge of an individual over a period of time is used as the basis for filling out a form.

Recording Techniques

- 1) Narration: summarial or in detailed sequence.
- 2) On-the-Spot Coding (qualitative measurement)
- 3) Rating (quantitative measurement)

Methods of Analysis

- 1) Classification
- 2) Interpretive study
- 3) Coding
- 4) Scoring
- 5) Statistical analysis

AIMS

Idiographic: factors revealing the variety or uniqueness of individual persons are described.

Normative: central behavior tendencies are related to a broad category such as age or sex.

Ecological: influence of environmental factors on behavior are described.

Systematic: behavior in general is studied, (instead of looking for camp behavior or boyish behavior one might look for attempts to influence others in relation to the success in influencing others (Lippit, Polansky and Rosen, 1952.)

Diary Description

Definition

Developmental changes in the life of an individual are described at regular intervals over a long period of time by an observer in close, continued contact with the individual being

observed. Some diaries are comprehensive, recording as much as possible. Others are topical, focusing on aspects of development. The longitudinal view of a person's life given in context can provide valuable raw material for cultural comparison as well as ideographic analysis. It lends itself well to use by parent or guardian.

Example Darwin, C. 1877. A biographical sketch of an infant. Mind, 2, 285-294

"On the seventh day, I touched the naked sole of his foot with a bit of paper, and he jerked it away, curling at the same time his toes, like a much older child when tickled. The perfection of these reflex movements shows that the extreme imperfection of the voluntary ones is not due to the state of the muscles or of the coordinating centers but to that of the seat of the will." p. 285.

Specimen Description

Definition

The observer gives an intensive narrative description, using ordinary language, of the behavior and the situation of an individual during a particular sequence of time. As much material as possible is included without conscious selection. Such descriptions can provide the raw material for almost all of the other methods of analysis, description and classification. The method is especially useful for ecological purposes and for subjects not easily explored in a laboratory situation.

Instructions Wright p. 84-85

"Begin in reporting each observed sequence with a description of the scene, the actors, and the ongoing action. Report throughout in everyday language. Describe the situation as fully as the behavior. Thus include 'everything the child says and does'; but include also 'everything said and done to him.'"

"Describe the larger 'adaptive actions' of the child, but weave in as well the 'hows' of these actions as far as possible. 'Nonadaptive aspects of behavior' (Stone, 1941) are important on this account. These include hunchings, turnings, twistings, and the like, which of ten illumine such properties of behavior as intensity, affect, and efficiency."

"Do not substitute interpretations that generalize about behavior for descriptions of behavior, but add such interpretations when they point to possibilities of fact that might otherwise be missed. Segregate every interpretation by some such device as indentation or bracketing. Strang reporting must be left to stand out..."

"...Notes on the scene of observation, which obviously are needed for sufficiently detailed and accurate description, can be kept in improvised shorthand. These field notes can be enlarged in writing immediately after each observation period, or they can serve then as a base for a dictated narration of the observed behavior sequence. Also a co-worker can hear this account through and at once question the observer where it is thin or unclear. The original dictation plus the interrogation and the observer's responses can be sound recorded. All of the recorded material can then be copied and revised in an improved running account."

"Observations can be timed to permit various measures of duration. Timing of the field notes at intervals of approximately one minute or even thirty seconds (Jersild and Fite, 1939; McFarland, 1938; Fite, 1940) has been found practicable. When long records are made, observers can work in rotation; and the time of each observing period can be regulated to minimize effects of fatigue upon ability to see and remember an always fast train of events."

Example Gump, P.V., and P.H. Schoggen. 1955a. Wally O'Neil at Camp. Wayne University (quoted from Wright, p. 85)

"The following is a part of a specimen day record from Gump and Schoggen (1955a), who were joined in the recording process by three others. All five observers took turns of thirty minutes each, in rotation, from 7:23 A.M. to 9:04 P.M. of the recorded day. The observations were recorded by the dictate-interrogate-revise technique, as described above. The setting is a summer camp, and the subject is 9-year-old Wally, whom the observer finds asleep in his cabin.

Noting Observer

7:23 Wally rolls over in the bed, opens his eyes, props himself up on one elbow, and looks with a sort of bewildered stare at me.

I am across the room from him.

Then he smiles briefly, as if he has caught on to what is going on.

Telling about Dream

He says to me, but also to others around, looking at them intermittently, but more at me, "Gee, do you know what happened to me last night?" He says this again with more earnestness, "Do you know what happened to me last night? I had a dream." Wally now sits straight up in the bed and begins to tell his dream in a serious, impressed tone of voice.

I dreamed that my Dad and I were riding in this big truck and we were coming down this hill and the driver, he was knocked out, and we couldn't drive the truck and the truck was going faster and we landed in the river with a big crash! Jeeze! I nod but nobody else makes any comment on this dream which was so vivid in Wally's mind when he awoke.

Event Sampling

Definition

A particular kind of behavior (arguments, sleep habits) is chosen and the observer waits for such events to occur, recording when and if they arise. Records used are either narrative description or a complicated check list of categories or some combination of the two as in a list of questions providing an open-ended guide for description. This method can serve the same function as an experiment if enough of the conditions and correlated changes of behavior are noted. The method lends itself to the study of those natural phenomena that can not be simulated in the laboratory or which occur too infrequently for consecutive study.

Example Dawe, Helen C. 1934. An analysis of two hundred quarrels of preschool children. Child Development, 5, 139-157. (quote from Wright p. 104-105).

"This modest investigation describes quarrels of preschool children 'as they occur spontaneously' during the free-play hour of a nursery school over a period of four autumn and winter months. The subjects are 19 girls and 21 boys of ages 2 to 5 years. Dawe 'watched the children from some central spot on the playground or from a doorway between the two main playrooms' of the school. 'Immediately upon noting evidences of a struggle' she 'moved quickly to the scene of action as unobtrusively as possible' and 'devoted her whole attention to the quarrel' until 'the issue was settled or the teacher interfered.' Each 'struggle' was timed from its inception to the outcome. 'Running notes' and also entries on prepared forms were recorded immediately after the conclusion of every quarrel. The forms gave space for recording-

- 1) the name, age and sex of every participant
- 2) the duration of the quarrel
- 3) what the children were doing at the time of onset
- 4) what they quarreled about: contested ownership, physical violence, interference with activity, or other social stress.
- 5) the role of each participant: precipitator, main aggressor, retaliator, objector, sheer emoter, or passive recipient
- 6) specific motor and verbal accompaniments

- 7) the outcome: yielding to force, voluntary yielding, compromise, interference by a teacher, and
- 8) the after effects: good cheer or resentment.

Here are some sample findings:

Two hundred quarrels were observed at the rate of three or four per hour among the 40 children. These quarrels were "amazingly short" indeed. Their average duration was twenty-four seconds, with only 13 lasting more than a minute. The time per quarrel was nearly twice as great outdoors as indoors. Quarrels stopped by teachers were not appreciably shorter than those settled by the children! The boys quarreled more often than the girls. Quarrels involving boys alone or girls alone were more frequent, but these intrasex quarrels ended with some form of compromise about three times as often as intersex quarrels! Sol Retaliative acts increased with age although the number of quarrels declined with age. Such motor quarrels! Truly argumentative quarrels increased with age, as Piaget (1952), for example, would assuredly have expected. Yielding to force was the commonest outcome. Quick and cheerful recoveries outnumbered resentful aftermaths about three to one. (Abstracted from Dawe. 1934.)"

Time Sampling

Definition

During short and uniform intervals of time, the observer watches a group of children and records the occurrence, frequency and duration of chosen kinds of behavior. The categories are coded in advance on check lists, rating scales or graphic devices. Only occasionally is narrative description used. Usually this is used in an institutional group with only one observational interval per child per day. The intervals of time have ranged from 5 to 20 minutes depending on the nature of the subject being recorded. Since the conditions surrounding the behavior are not noted, time sampling has limited uses, mainly to determine frequency or duration of specific behavior, especially in connection with providing already formulated hypotheses. One study, for instance, was done to prove a thesis that more aggressive actions would occur in a lower class group of children than a middle class group. Time sampling can be used as a method of analyzing fuller contextual records by dividing the record into intervals and counting the frequency and duration of occurrences.

Example Olson, W.C. 1929. The measurement of nervous habits in normal children. Minneapolis: University Minnesota Press.

Field Unit AnalysisDefinition

On the spot observation notes are made by giving participial titles to events as they occur. The duration of the events is also recorded. Immediately afterwards the observer fills in recalled details under each participial title. This method stresses the relationship, overlap and context of one event to another.

Example Wright, H. F. 1957. The city-town project: Aims and methods. Unpublished manuscript. University of Kansas.

A child is observed for twenty to thirty minutes as he goes about his business in a community. His behavior is divided into episodes on the basis of those actions which fulfill a particular intention he has made evident. Examples of the participial titles given the episodes are "Buying Oranges" and "Discussing Tornado with Banker."

Trait RatingDefinition

After careful observation in an interview or after a period of observation based on general knowledge of the individual a check list of traits is filled in by the observer concerning an individual. Frequently the traits are given measures such as never, sometimes and often. These records are frequently used by teachers. Traits often noted are cheerfulness, jealousy, apprehensiveness, curiosity, playfulness, fancifulness, conformity, friendliness, competitiveness, respect for authority, sense of humor and adaptability to new situations. Traits reflecting the level of maturity in various acquired skills or in motor development might be more precise traits to record with this non contextual method, than spontaneous emotional reactions and social behavior.

Example Haggerty, M.E., W.C. Olson and E.K. Wickman. 1930. Haggerty-Olson-Wickman behavior rating schedules. Yonkers, New York: World Book.

Work

Note when a child begins to occupy himself for any length of time upon a task; what the task is; how long he continues at it; his speed in completing it and whether he repeats it.

What individual peculiarities does he have in performing particular tasks?

What tasks does he choose in the course of one day and in which does he perservere.

Does he have periods of spontaneous industry? How many days does this continue?

How does he show he wants to improve or learn new things?

What tasks does he choose in a steady sequence?

Can he persist in any kinds of tasks despite distraction?

If there has been an interruption can he resume working on his previous task?

Conduct

Are his actions orderly?

What kinds of disorderly action does he engage in?

When he is involved in a task notice what changes in behavior may occur, what moments bring joy, serenity or show of affection.

What part does the child take in the development of the other children?

Obedience

Does he come when called?

Note if and when the child begins to take part in the work of others with an intelligent effort.

Note when the obedience to a summons becomes regular.

Note when obedience to orders becomes established.

Note when the child obeys eagerly and joyously.

Note the relation of the various phenomena of obedience in their degrees to the development of work and to changes in conduct.

COLLECTED PAPERS

1. "My System of Education" address delivered by Dr. Maria Montessori at the N.E.A. Congress, 1915.
2. Six Methods of Observational Child Study by Herbert F. Wright abstract from an article published in the Handbook of Research Methods in Child Development.
3. Observation: Suggestions for Observing and Recording Children's Behavior.
4. Guide to Psychological Observation from Maria Montessori: The Advanced Montessori Method.

MONTESSORI TEACHER
TRAINING PROGRAM

"MY SYSTEM OF EDUCATION" address delivered by
Dr. Maria Montessori at the N.E.A. Congress, 1915

My system is to be considered a system leading up, in a general way, to education. It can be followed not only in the education of little children from three to six years of age, but can be extended to children up to ten years of age. It is not a simple theory, but has been experimented with and put into practice. Its results constitute a scientific proof of its value.

Altho the first part of my experiment deals only with children between the ages of three and six years, nevertheless it must be considered as a "directive system" for the education of all children having attained the school age. In fact, my last experiments, not yet known to the public, have been made on children up to ten years of age, and the same directive system has proven satisfactory. The results were of still higher importance than in the first case with smaller children because richer in practical evidence both in the formation of character and in the attainment of knowledge.

The fact on which it was possible to establish my system is the psychologic fact of the "attention" of the child, intensively chained to any exterior object or fact, which proves in the child a spontaneous, altho complex activity of its entire little personality.

It will be of some interest to relate here the episode that made me decide to plan out a special method for the education of children.

I was making the first experiments in San Lorenzo (Roma), trying to apply my principles and part of the material that I had previously used in the education of backward children.

A little girl, about three years of age, was deeply absorbed in the work of placing wooden blocks and cylinders in a frame for that purpose. The expression of her face was that of such intense attention, that it was almost a revelation to me. Never before had I seen a child look with such "fixedness" upon an object, and my conviction about the instability of attention which goes incessantly from one thing to another, a fact which is so characteristic in little children, made the phenomenon the more remarkable to me.

I watched the child without interrupting her, and counted how many times she would do her work over and over. It seemed that she was never going to stop. As I saw that it would take a very long time, I took the little armchair on which she was sitting and placed child and chair on the big table. Hastily she put the frame across the chair, gathered blocks and cylinders in her lap, and continued her work undisturbed. I invited the other children to sing, but the little girl went on with her work and continued even after the singing had ceased. I counted forty-four different exercises which she made, and when she finally stopped, and did

so absolutely independently from an exterior cause that could disturb her, she looked around with an expression of great satisfaction, as if she were awakening from a deep and restful sleep.

The impression I received from the observation was that of a discovery. The same phenomenon became very common among those children, and it was noticed in every school in every country where my system was introduced; therefore it can be considered as a constant reaction which takes place in connection with certain exterior conditions that can be well established. Each time a similar "polarization" of the attention occurred, the child began to transmute itself completely; it became calmer, more expressive, more intelligent, and evidenced extraordinary interior qualities, which recalled the phenomena of the highest mentality. When the phenomenon of polarization of the attention had occurred, all that was confused and drafting in the conscience of the child seemed to assume a form, the marvelous characters of which were reproduced in each individual.

This reminded one of the life of man that may be scattered indiscriminately in a chaotic condition, until a special object attracts it and gives it a fixed form, and then only is man revealed unto himself and begins to live. This spiritual phenomenon, which may coinvolve the whole conscience of the adult, is therefore but one of the ever-present aspects of the "formation of the inner life." It is met with as a normal beginning of the inner life of children, and it follows the development so as to come within the reach of research as an experimental fact.

It was thus that the soul of the child gave its revelations, and, guided by these revelations, there arose a method where spiritual liberty became demonstrated.

The news of this fact rapidly spread thruout the world, and it was received at first as a miracle. Then little by little, as the experiments were repeated among the most diverse races, the simplicity and evidence of the principles of this spiritual treatment were recognized.

When you have solved the problem of controlling the attention of the child, you have solved the entire problem of its education. The importance of a scheme to concentrate the attention is self-evident. Professor William James, the renowned authority on psychology in America, points out to us how there exists in children that exterior variability of attention that makes it so difficult to give them the first lessons. The reflective and passive character of the attention, by which the child seems to belong less to itself than to any object that may attract its attention, is the first thing that the teacher must conquer. The ability incessantly to recall a wandering and scattered attention, always ready to vanish, is the real root of judgment, character, and will; that system of education that succeeds in bringing this faculty to the highest degree should be the ideal and standard system.

To be able to choose objects that will interest and hold the attention of the child is to know the means of aiding it in its mental development. All things which naturally arise and hold the attention with considerable steadiness are those which represent a "necessity" for the child. Toward these things its attention is directed in a natural, almost instinctive way. All other things that attract its attention do so only lightly, transitorily, and for a very short period of time. Thus the newborn child has a series of unco-ordinate movements, but the complex movement of sucking, which is in direct proportion to its need of food, is performed with regularity, co-ordination, and steadiness. We must recognize that something like this is needed for its psychic development.

Consider the little girl only three years of age who performs the same exercise fifty times. A crowd is roaming about her, a piano is playing, a chorus is sung, and nothing can distract her from her deep concentration. In a similar way, the baby holds on to the breast of the mother without being interrupted by any exterior agent and lets go only after its need is satisfied.

How shall we choose the means of development by experiments? Since a constant and peculiar psychic reaction is an established fact, it is possible to determine some stimulating (reactive) agents or objects that can aid the spontaneous development. The character of this reaction itself must be the guide to the choice of these objects which are to constitute the implements or tools for this scientific work.

Each one of these instruments must be built with every detail to answer the purpose. As the lenses of the optician are made in accordance with the laws of refraction, the pedagogical instrument must be chosen to correspond exactly to the psychic manifestations of the child.

Such an instrument could be compared to a systematized mental test. It is not, however, established as an external criterion of measurement with the purpose of estimating the instantaneous psychic reaction which it produces, but on the contrary it is a stimulus which must be determined by the psychic reactions which it is capable of producing and maintaining in a permanent manner. It is the psychic reaction which determines and establishes the systematic mental test and the psychic reaction which serves as the sole means of comparison in determining the tests. It is a polarization of the attention and the repetition of the acts to which it corresponds. When a stimulus corresponds in this way to the reflex personality, it serves, not to measure, but to maintain an active reaction. Therefore it is a stimulus of inner formation. In fact, it is upon such activity, aroused and maintained, that the associative organism begins its inner elaborations in relation to the stimuli.

It is not as a scale for weighing personality that this science comes into the old sphere of pedagogy as it was in the case of the

experimental psychology introduced in the school up to the present time. It is a science intended for the purpose of "transforming" personality, thus taking the place of a true and real pedagogy. While old pedagogy in all its different interpretations had for its point of view and starting-base the conception of a "receptive personality," which was supposed to receive tuition and allow itself to be passively transformed, this scientific direction presupposes an active personality, reflective and associative, whose activity manifests itself thru a series of reactions derived from systematic stimuli chosen by experiments. This new "pedagogy" belongs therefore to the series of modern sciences not of old speculations. But the method that embodies it, that is to say the attempt, observation, retrying, taking notice of new phenomena, the reproduction of said phenomena and utilizing them, places this new pedagogy among the experimental sciences.

Nothing is more interesting than these experiments. By them we can establish, with the greatest precision, all necessary exterior stimuli definite in their qualities and quantity. Small frames, for instance, of different forms, arouse only a temporary and transient attention in a child three years of age; but, gradually enlarging the size of the frames, you will reach that limit at which the attention is steadily held, the activity stimulated by them will be permanent, and the exercise set up in it becomes a factor of development. The experiment is repeated on several children and we come to the point where we can establish the right size of a series of objects; in the same way we can proceed to determine the color and all other qualities of your material. In order that a quality be "felt" so intensely as to hold the attention, a sufficient size and intensity are required in the stimulus. These can be determined by the degree of psychic reaction in the child in the same way that you establish which is the smallest size of colored surface which can attract the attention of the child upon the colored tablets, and so forth. The quality, then, is determined by the psychic experiment and the activity that it provokes in the child, who remains absorbed for a considerable length of time working on the same subject. It is while in this state that the phenomenon of interior development and auto-formation takes place.

Of the qualities of the objects one must be picked out which stimulates principally the highest activities of the intelligence; this is the quality that enables the child to verify mistakes. In order to create a process of auto-education, it is not sufficient that the stimulus arouses an activity, it must at the same time direct it; the child must not only be occupied for a long time on an exercise, but it must continue on it without making mistakes.

All the physical or intrinsic qualities of the objects must be determined aside from the immediate reaction of attention provoked in the child, also this fundamental characteristic of permitting the control of error, that is, to summon the active collaboration of high activities, such as comparison and judgment. For example, one of the first objects which attracts the attention

of the three-year-old child, the solid insets (a series of little cylinders of various dimensions which are taken out and replaced), contains the most mechanical control, because in making one mistake in the replacing of the cylinders, one of them is left without a place. Hence a mistake is an obstacle which can be surmounted only by correction, otherwise the exercise can proceed no farther. Furthermore, the correction is so easy that the child accomplishes it by himself. The little problem which has unexpectedly sprung up before the child like a jack-in-the-box has interested him.

It may be noted, however, that the problem which has arisen is not of itself a stimulus to the interest--does not urge the child on to the repetition of the act, or to progress. That which interests the child is not only the sense of handling the objects, but the conscious acquisition of a new power of discrimination, that of recognizing the differences of dimensions among the cylinders, the difference which at first he did not perceive. The problem arises only in relation to the mistake--it does not accompany the normal process of development. An interest simply stimulated by curiosity in the problem would not be that formative interest which draws its sources from the needs of life itself and which, therefore, directs the construction of the inner personality. If it were only the problem which led the soul along, it might lose its own spontaneous order as every other external cause which strives to lead life astray on false paths.

On the other hand, the experimental criterion for determining the number of objects is quite different. When the instruments have been constructed with great precision, they provoke an auto-exercise so orderly and responding to the facts of inner development in such a way that at a certain point a new psychic picture is revealed, a sort of upper plane in the complete development.

Then the child spontaneously abandons the objects, but not with signs of fatigue, altho he is carried along by new energy and his mind is capable of abstraction. At this stage of development the child turns his attention to the external world and observes it in an orderly manner, according to the order which has been formed in his mind along with the preceding development, and he unconsciously begins to make a series of measured and logical comparisons which represents a real spontaneous acquisition of knowledge. This is the stage henceforth known as the Period of Discovery, discovering which evokes in the child enthusiasm and joy.

This higher stage of development is most fruitful because of its later growth. It is necessary that the child's attention should not be detained on these objects when the delicate phenomenon of abstraction begins. For example: The teacher who should at such a moment call the child to renew his activity with the object would in so doing retard his spontaneous development, would put an obstacle in his path. When that enthusiasm which leads the child to uplift himself and to experience so many intellectual emotions is spent, then one road to progress is closed. The same mistake may be made thru an overabundance of material since it may distract the attention,

may cause the use of the material to become mechanical, and may cause the child to pass by his psychological moment without seizing it or even being aware of it. These extra objects (materials) are useless and amid them the soul may lose itself. What must be accurately determined is how much material is necessary and sufficient to respond to the needs of the inner life in its development. The observation of the child's expression and of the manifestations of his activities as a whole are the guiding factors in determining the quantity.

Perhaps I insist too much on this point in order to reply to the many important objections and suggestions which have been made to me, because there are those who think that the form alone of the problem is able to arouse the interest.

In the second series of objects used to educate the eye to dimensions, the control of the error is not mechanical but psychological. The child himself, since his eye is already taught to recognize differences of dimension, will see the error if only the objects are of fixed dimensions and highly colored. For this reason the succeeding objects contain a control of error in their very size and vivid colorings. A control of error of quite a different kind and of a much higher order is found in the material used for the multiplication table where the control consists in comparing the work itself with the answer, a comparison which necessitates a marked effort of the child's intellect and will and which henceforth places him amid true conditions of a conscious auto-education. The seeming distraction is revealed in its real essence by the happy expression of the children's serious faces animated by the keenest joy. The child, to all appearances, does nothing, but only for a minute; shortly he will speak and will tell us what is taking place within him and then an outburst of activity will carry him on a round of continuous explorations and discoveries. He is saved.

On the other hand, here are other children who experienced the same primitive phenomena, but they were surrounded with too many objects. At the moment of maturity they felt themselves seized, forced, actually "bound with cords" to earth. A diminution of the intensity of the attention given to new objects, instability, and hence weariness are made manifest by the cessation of inner activity. The child gives way to lower tendencies, foolish laughter, and disorderly acts. He asks for more objects and still more objects, because he has remained imprisoned in the "vicious whirl of vanities" and he no longer feels the need of gaining relief from his ennui. Such is also the fate of an adult who, in life's chaos has committed a like error--he becomes undisciplined, weak, and "is in danger of losing himself." If someone does not help him and, tearing away all unnecessary objects, point out to him "his heaven," it will be difficult for him to have the energy to attain it by himself.

These two extreme types give an idea of the criteria by which one determines in an experiment the "quantity" of the objects used for development. The "too much" weakens and retards progress. This

has been proven again and again by all my collaborators. If, on the other hand, the material is insufficient and the natural auto-exercises are unable to lead up to that state of maturity which raises one, there is no outburst of that spontaneous phenomenon of abstraction which is the second step in that auto-education which goes forward in infinite progression.

The same fundamental phenomenon of intense and prolonged attention leading to a repetition of acts guides one in finding the stimuli which are suitable to the child's age. A stimulus which causes a child of three to repeat an act forty times in succession may cause another child of six to repeat the same act only ten times; the object which quickens the interest of the three-year-old cannot quicken the interest of the six-year-old child. However, the child of six is capable of far greater attention than the three-year-old, when the stimulus is in direct relation to his activity. If the child of three has a maximum power of repetition, say of forty times in succession, the six-year-old is able to repeat an act in which he is interested two hundred times. If in the case of a three-year-old child the maximum period of continuous work on the same object is half an hour, for the six-year-old it may be more than two hours.

Thus tests give positive psychic characteristics which can almost be measured according to age. Analogously, since there are for the various ages materials for progressive development upon which the various personalities can react differently, it is possible to determine with scientific precision the level of the average psychical development according to age, a precision which I consider the famous Binet and Simon tests are far from attaining. A relationship is established between the inner needs and the stimuli.

This is a suggestion, however incomplete and insufficient, of the "possibility" of experimentally determining the means for psychic development. They can really be established and with such precision as to bring into existence a real relationship between the inner needs and the stimuli, just as there exists a relationship of form between the insect and the flower. That is to say, there remains in the organization of the external means for inner development "a material imprint," and this is that of which the soul has need in its path, in its course, in its flights. The material part does not contain the imprint of the whole soul, as the imprint of the foot does not give the imprint of the whole body, as the aviation field is not the place for the extensive course of an aeroplane, but is only a piece of terra firma necessary for the flight, and is also the resting-place, the refuge, the shed to which the aeroplane must always return. Thus, in the psychic formation, there is a material part necessary in order that the spirit may lift itself, and there the spirit must seek support, rest, and refuge. Without this, it cannot grow and rise "freely".

In order that this material may be a real support, it must reproduce and contain within itself those forms which correspond

to the needs of material help. Thus, for example, in the first part of the psychic life, the material corresponds to the primitive exercising of the senses and is determined in quality and quantity by the sensorial needs supplied by nature, corresponding to the exercise of the activity sufficient in order to mature a superior psychic state of observation and abstraction. Vice versa, nothing in the material corresponds to the successive course thru the world which the infantile spirit completes with such rapture, making great acquisitions of knowledge. Then we see the spirit crying out for exercises of a higher order and behold the same primitive phenomenon of the attention, which henceforth is exercised on the alphabet and on the material for arithmetic, repeating in a more complex form the methodical exercises of the intellect, by correlating the auditory impressions with the visual and motor impressions in the written and spoken word, and in the positive study of quantity, proportions, and number. Then the same accompanying phenomena are manifested which are the concomitants of patience, of constancy, and, at the same time, of vivacity and joy, and characteristic of the spirit when the inner energy has found its outlet. The field in which it can exercise itself comfortably and quietly enlarges and the spirit which becomes organized in such a way under the guidance of an order which responds to its natural order, becomes strong, grows flourishingly, and manifests itself in equilibrium, serenity, and calm, which then gives that wonderful discipline characteristic of the conduct of our children.

The practical consequences of such a system of education are: the easy and spontaneous solution of pedagogical problems considered impossible to solve; the realization of ideals thought to be utopian.

From such a system there comes forth a school where the children work for themselves--that is, they are free. In this freedom they work much more than heretofore has been customary in school, not alone without fatigue, but with renewed nervous forces, and they attain culture more rapidly and more efficaciously--that is, they surpass the ordinary level. In fact, children can learn to read and write at four and one-half years of age generally, and in the elementary schools they save from one to two years. This educational problem, which today science propounds, is solved, tho it was considered among the insoluble questions such as the fourth dimension, perpetual motion, and the squaring of a circle. The problem is to lessen effort and at the same time increase output. In fact, the overworking of pupils has forced hygiene to insist on less work, whereas social progress requires that the schools produce men even more cultured.

Furthermore, children brought up under our method acquire a salient personality, a peculiar formation of character, and they are capable of perfect discipline, a thing which solved the problem of liberty. For liberty, as it has been tried up to now, brought about either disorder and lack of discipline or a lessening of scholarship. In truth the solution of the question of freedom depends entirely on finding the means which will serve as an aid

to spontaneous psychic development, to character and to intellectual culture. In this manner auto-education is also attained, a thing which is impossible unless we determine with precision the means necessary for the child to educate himself--that is, to develop his own activities.

Finally, in such a way is a true positive science of education initiated which up to the present has not been given by pedagogical anthropology nor by German experimental psychology with its applications to the school in the branch called "scientific pedagogy." Such sciences have studied the personality of the pupil but have not changed it, they have pointed out and analyzed the errors of the school, but they have not reconstructed. Besides, if from these sciences there had really arisen a scientific pedagogy capable of transforming man, as the other positive sciences have transformed the environment, it would not have left educators and the public so indifferent; it would have aroused a popular interest since children and the schools are of common interest to all mankind.

The scientific pedagogy, as understood thus far, does not indeed present anything but the ideal for establishing pedagogy on the lines of positive and experimental sciences in accordance with the progress of the time and not the realization of such an ideal. In fact, the scientific laboratory of experimental pedagogy cannot be other than the school itself, where the children live and are transformed. I believe that my system of education is founding this laboratory where the first germs of a science of man are visible because of the precision of systematic means, and also because of the effect upon human development.